Electrical World

The consolidation of ELECTRICAL WORLD and ENGINEER AND AMERICAN ELECTRICIAN.

VOL. LVI. NEW YORK, THURSDAY, NOVEMBER 10, 1910. No. 19.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

239 WEST THIRTY-NINTH STREET, NEW YORK

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TERMS OF SUBSCRIPTION.

United States, Cuba and Mexico, $3.00 per year; Canada, $4.50 per year. All Other Countries, $6.00 per year. Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. Date on wrapper indicates the month at the end of which subscription expires.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of Electrical World for 1909 was 945,850. Of this issue 17,250 copies are printed.

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INCREASING EXPORTS.

The increase in electrical exports noted for the whole of last year, and continued into the present fiscal year, is sustained in the figures for September, of which the general statistics have just been issued by the Department of Commerce and Labor. In both smaller apparatus and heavy machinery the gain is marked. The report of electrical apparatus was not less than $762,152, as compared with $686,049 a year ago; while in heavy electrical machinery the advance was from $480,835 to $578,246. The increase is perhaps not so great as in some previous months, but on the other hand, foreign or international trade as a whole was not brisk; so that it is satisfactory to see the tendency maintained. Canada appears to have been an active purchaser, for her takings of machinery rose from $37,220 to $100,665, and in light apparatus her demands were also larger. Japan also increased in machinery from $89,696 to $129,665. There is not, however, much that calls for special attention in the data, beyond the fact that conditions remain very hopeful and encouraging.

MAGNETIC LEAKAGE IN TRANSFORMERS.

An alternating-current transformer is a wonderfully effective and efficient device, but it has certain defects. One of these defects is a magnetic leakage whereby a portion of the magnetic flux attending the excitation of one winding links only with that winding and escapes being linked completely with the other winding. In a perfect transformer all of the magnetic flux produced by sending current through one winding, say the primary, would pass through the core and would thus link with the secondary winding. In the absence of any magnetically insulating substance such a confinement of magnetic flux to the core is a present impossibility. The result is that every transformer behaves like the combination of a perfect transformer devoid of leakage, plus an external choking coil in the circuit of each winding. The smaller the magnetic leakage the smaller the equivalent auxiliary choking coil in primary and secondary circuits, and the larger the equivalent pure transformer. Another way of expressing the same relations is by the use of a "coupling coefficient," which may be defined as the ratio of the flux linked by one coil with the other to the total flux the coil produces. The coupling coefficient may be as low as 5 per cent in the case of an air-core transformer with large, widely separated turns, as used in wireless telegraphy, and as high as 99 per cent in particular types, sizes and constructions of transformers, especially for laboratory use. In the former case 95 per cent of the flux would be leakage flux, and in the latter only 1 per cent.

An article by Herr W. Rogowski in the *Elektrotechnische Zeitschrift*, an abstract of which appears in the Digest, deals with the measurement, predetermination and geometrical distribution of leakage magnetic flux, or stray field, in transformers. It is shown that in a level transformer, or device with equal numbers of turns in the two windings, the leakage flux is the self-inductance of the device when the two windings are connected in opposition series. Consequently, the leakage

can be found by measuring the self-inductance of the transformer under those conditions. In the case of the ordinary step-up or step-down transformer the measurement is not so simple, but the amp-turns in the primary can be brought into equality with, and opposition to, the amp-turns in the secondary by the aid of certain auxiliary devices, when the self-inductance of the apparatus may be measured as before and the magnetic leakage evaluated.

CONDENSER EFFECTS IN INSULATORS.

Not until relatively recent years has proper attention been paid to the condenser relations in insulating materials. Thickness of insulation and distance between supports by the most direct path over the "leakage surface" seem usually to have been the only factors considered when dealing with the dielectric properties of insulators during the earlier years of the industry. At the present time, however, the condenser effects are being considered in connection not only with line insulators, but also with cable cores, transformer terminals and armature coils. Marked progress has resulted from the application of the laws of condensers in the design of each of these classes of apparatus, with the possible exception of the last; and to the extent that practical limits are being reached in the construction of armatures, the condenser effects are now being studied, so that much progress is to be expected along this line also. In the case of transmission-line insulators the limit of practical operating e.m.f. was reached at from 60,000 volts to 80,000 volts with the pin type of insulator, while with the suspension type the limit has been entirely removed so far as the insulator itself is concerned, the maximum permissible operating e.m.f. being set solely by the relation between the size of the conductors and their interspacing. These facts are discussed in detail in an article appearing on page 1127 of this issue.

Quite independent of any factors which may have dictated the proportioning of a transmission-line insulator, the line itself forms one plate of a condenser, the support forms the other plate, and the insulating material and surrounding air form the dielectric. When the insulator "breaks down" its failure is attributed to the concentration of the electrostatic flux at some point to a value sufficient to rupture immediately, or overheat by hysteresis, the dielectric at that point, just as is true in any condenser. Whether the rupture takes place within the solid portion of the insulator or in the surrounding air depends in part upon the relative dimensions of the several sections of the dielectric, but most largely upon the arrangement of the solid insulating material with reference to the exposed edges of the line plate and the supporting plate of the condenser. Since in any event the breakdown occurs at that point where the ratio of dielectric flux concentration to the strength to withstand rupture is a maximum, economy of material would dictate the selection of an arrangement such that this ratio is as nearly as possible constant throughout the whole dielectric. Experience has shown that even when this plan is followed in so far as atmospheric conditions and mechanical requirements will permit, there is reached a certain limiting e.m.f. above which it is uneconomical to design an insulator of the single-condenser type. Evidently, several of the high-voltage condensers can be connected in series for operation at higher electromotive forces, and by using a sufficient number of condensers in series the voltage per condenser can be reduced to any desired value. Transmission-line insulators of the suspension type, which represent the most recent development, are in reality mere high-voltage condensers connected in series. Little difficulty is encountered in designing such insulators to fulfil the condenser requirements, the chief problems being those relating to mechanical requirements.

THE NATURAL WAVE LENGTH OF ELECTRIC OSCILLATORS.

The wave length of a simple musical sound wave emitted by a stretched vibrating string, such as a pianoforte string, does not bear any simple relation to the length of the string. It depends upon the length of the string, but also upon the tension and upon the mass of the string per unit length. It is only when we keep the tension and linear mass uniform that a simple relation is found between the length of a simply vibrating string and the length of the sound wave it emits. In dealing with electromagnetic waves generally, and particularly in dealing with the electromagnetic waves emitted by wireless telegraph oscillators, it is important to know what relation exists between the height of the oscillator and the length of the emitted wave. Of course, the wave length can be altered artificially by inserting inductances or capacities into the antenna circuit. But the principal subject of interest in such an inquiry is the natural wave length of a vertical single-wire antenna when freed from all encumbrances or artificial loads and connected to good ground at the base. From a theoretical standpoint this question is directly associated with another, which takes precedence in natural order of analysis—namely, what is the wave length emitted by a uniform straight-rod oscillator, in free space, with a spark-gap at the center of its length? If we know the answer to this question, the question of the grounded vertical antenna is solved at once.

It would seem very easy to find an answer to the double-oscillator problem, either experimentally or mathematically, or both. But the answer is not so easy. From the mathematical standpoint there are at least two schools of thought. One school, led by Abraham, maintains that the wave length of a free double oscillator is a little over, and usually only a few per cent over, twice its length as a rod; so that a rod 10 m long, with a small spark-gap in the middle, would emit a fundamental wave whose length would be a few centimeters more than 20 m. The other school, led by Macdonald, maintains that the wave length is a little over two and a half times the rod length, so that the 10-m free double oscillator would give a fundamental wave about 25 m long. There is obviously a very distinct difference between these conclusions. Experimentally double oscillators of known dimensions have been operated at fundamental frequency, and resonators have been placed in their vicinity to measure the wave length emitted. A resonator usually consists of a conductor just like the oscillator, but arranged as a receiver instead of a transmitter, and with its dimensions adjustable. The length of the resonator is adjusted until the maximum strength of response is found to the waves under investigation. Next arises the question, however, as to what relation there is between the best length of the resonator and the length of the incident wave. Here the same debate recommences under a new title.

In a recent number of the *Physical Review* Prof. J. E. Ives describes some experiments in which the wave length was measured by interference methods. A very short oscillator was

operated before electrical mirrors in such a way as to produce interference between two dividing wave trains. The positions of interference were noted, and the length of the waves was inferred from them. Various difficulties had to be overcome. First of all, the length of the resonator was found to affect the results, whereas a strict interference method should eliminate the influence of the receiver. This difficulty was traced to the use of a low-resistance resonator, which was enabled to set up oscillations of its own pitch when excited by incident waves. By using resonators of considerable resistance their vibrations were damped and held in check, so that the influence of the receiver upon the measurements was greatly reduced. The results of the experiments are claimed as a corroboration of the Abraham theory. Thus, an oscillator 4.93 cm (1.94 in.) long was found to emit waves 10.42 cm (4.11 in.) long, or within 3 per cent of the Abraham formula, which involves the ratio of length to diameter of rod in such a way that the longer and thinner the rod the smaller the excess in the wave length over double the rod length.

Assuming, then, that it has been demonstrated experimentally that the wave length of a free double oscillator is a little over twice its rod length, then the wave length of a single vertical and grounded rod oscillator will be a little over four times its rod height. Expressing the same fact in reverse order, a single-rod vertical and perfectly grounded antenna will be a few per cent less in height than its quarter wave length. With this understanding it is the more easy to determine the wave length as modified by such condensers and reactances as may be used in connection with the antenna. Incidentally, the experiments bear an additional interpretation. It has been known for some years, both from theory and from experiment, that electric waves run over perfectly conducting wires, supported parallel to each other, at the speed of light in air. It has come, therefore, to be believed that such waves run over a single horizontal wire, with ground return, at the same speed. But it has been open to question whether they run over a single vertical wire at the same speed. The linear capacity and inductance of such a vertical wire are not constant, whereas they are manifestly constant for a long horizontal wire. The result of the Ives experiments leads now to the conclusion that over a vertical as well as over a horizontal wire electric waves travel substantially with the velocity of light.

POWER-FACTOR AND ROTARY CONDENSERS.

Fortunately for electrotechnics and for electrical engineers the alternating-current generator and circuit came into general use after the direct-current generator and circuit had already become familiar and understood. In this order of sequence the inherent idiosyncrasies of the alternating-current circuit were more easily analyzed and mastered than if the order had been reversed and no preliminary experience had been provided with the relatively simple direct-current circuit. The power-factor phenomenon, for example, is peculiar to the alternating-current circuit, and a grasp of its details would have been rendered much more difficult if the simpler laws of the direct-current circuit had not first been recognized and then modified by extension so as to include the alternating-current case. When a direct-current generator supplies, say, 50 amp to an ordinary direct-current circuit, under a pressure of 100 volts, it inevitably supplies 5 kw of power to that circuit; or energy is liberated from the circuit at the rate of 5000 joules in each second of time. When, however, an alternator supplies 50 amp to an ordinary single-phase circuit, under a pressure of 100 volts, it also inevitably supplies 5 kw of vector resultant power to that circuit. All of this power is, however, not liberated from the circuit, part passing to and fro between different parts of the circuit. Under ordinary practical conditions perhaps out of the 5 kw generated 4 kw may be liberated from the circuit. Under unusual practical conditions, or conditions rarely met with outside of the laboratory, only 50 watts of the total apparent 5000 watts may be liberated from the circuit.

The power-factor of the circuit, or ratio of liberated to vector generated power, is 80 per cent in the first case and 1 per cent in the second. The vector balance of the power, or the undelivered balance geometrically subtracted, is exerted either in delivering energy from the generator to magnetic fields, say, induction-motor fields, and back again, once in each current alternation, or in delivering energy from the generator to electric fields, say, condensers, and back again, once in each voltage alternation. This reactive energy, which bustles to and fro in the circuit, without escaping therefrom, is just as much energy as that which is delivered from the circuit to lamps or motors. Likewise, the bustle activity, or reactive power, of pushing the reactive energy to and fro along the circuit to magnetic fields or condensers is just as truly power as that which is liberated externally to lamps or motors. The only difference between the reactive power, or watts in the circuit fields, and the effective power, or watts directed out of the circuit, is that the former is unnecessary and obstructive power, from an engineering and economical standpoint, while the latter is useful and available power. No useful purpose is ordinarily subserved by reactive power except in an incidental and roundabout way. Useful commercial purposes are subserved by effective power. Reactive power costs money to a power plant by interfering with the effective power, which latter earns money for the plant. Nevertheless, it is a misuse of terms to call the reactive power "wattless power," or the current which carries it "wattless current." One might almost as well say that on board a steamship all the power which was utilized in the auxiliary engines was wattless power, and the current of steam delivered to the auxiliaries wattless current, merely because these are not delivered to the main engines that drive the propeller.

In the article on page 1125 Mr. L. S. Thurston point out the advantages of "rotary condensers" operating in connection with a system of low power-factor. It is clearly shown that the best theoretical economy is obtainable from such machines when delivering 70.7 per cent of their kva input in available mechanical power, and also 70.7 per cent in reactive leading power to those devices within the circuit which absorb reactive lagging power. By this means it is possible not only to obtain a very fair mechanical output from the "rotary condenser," considered as a synchronous motor, but also to improve the regulation of pressure on the system and to increase the effective output of the generating plant. It is seldom that the demands of a system in regard merely to regulation or increased output require to be met, in the judgment of the manager, by the installation of a rotary condenser; but where a synchronous motor is needed at some suitable point on the circuit the advantage of making the motor serve the double purpose of delivering mechanical power and carrying the reactive load, without great increase in size and cost, is finding favor increasingly.

Meetings of the A. I. E. E.

A meeting of the American Institute of Electrical Engineers will be held in New York on Nov. 11, at which time a paper entitled *Interpoles and Synchronous Converters* will be presented by Messrs. B. G. Lamme and F. D. Newbury.

On Nov. 30 a joint meeting will be held with the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Society of Civil Engineers to present the John Fritz medal for 1910 to Mr. Alfred Noble "for notable achievements in civil engineering." Dr. Samuel Sheldon, past-president of the American Institute of Electrical Engineers, will preside, and addresses will be made by Messrs. Isham Randolph and R. W. Raymond and others.

A meeting of the Toronto Section of the A. I. E. E. will be held on Nov. 11, when a paper will be read by Mr. H. H. Morrell entitled *Storage Batteries*. The Washington (D. C.) Section will hold a meeting on Nov. 8 to discuss the subject "Search Lanterns." The speakers will be Commander S. S. Robinson, United States Navy, and Lieut. William H. Rose, Corps of Engineers, United States Army.

The Portland (Ore.) Section has prepared a schedule of papers for its next four meetings, as follows: Nov. 15, *High-Tension Transmission*, by Mr. H. R. Wakeman; Dec. 13, *The Electric Railway*, by Mr. W. H. Evans; Jan. 17, *Conservation of Natural Resources*, by Mr. E. J. Griffith; Feb. 21, *Telegraph and Telephone Work*, by Mr. E. L. Ritter.

Government Control of Wireless.

In his annual report to the Secretary of War, which has just been published, Brig.-Gen. James Allen, chief signal officer of the United States Army, takes issue with the operating commercial wireless telegraph companies that claim to have efficient interference preventers, and, deploring the confusion which he states exists everywhere in the transmission of government messages, urges that measures be taken at once to secure government control of wireless telegraphy, both in peace and war.

Referring to the Berlin international agreement of 1906 he says: "As the United States up to this time has not given its adherence to the convention, ships flying the American flag find themselves without standing in international wireless telegraph circles, as none of the contracting countries is compelled to receive a telegram from a vessel of a non-contracting nation, and any coastal station in a foreign country may refuse to transmit a message to a station on shipboard which is subject to a non-contracting nation.

"The history of the whole matter is recorded in a published copy of the treaty (Government Printing Office, 1907) issued by the Bureau of Equipment, Navy Department; in the report of the United States Ambassador to Germany, 1906, and in Senate Document No. 452. The only action of the United States government looking to the regulation of wireless telegraphy is the approval of the President, July 29, 1904, of the report of an inter-departmental board convened to investigate the entire question of wireless telegraphy in the service of the national government.

"Owing to the absence of definite regulations there is great confusion in the transmission of wireless messages on the coast of the United States, which interferes very materially with wireless communication between the various sea-coast defenses and with our ships at sea. The army now has fifteen wireless stations on shore located at various points in the United States and Alaska."

Investigation of Street Lighting in Chicago.

The Chicago Commission on City Expenditures, generally known as the Merriam Commission, from its chairman, Alderman C. E. Merriam, who is also a professor in the University of Chicago, has been investigating various departments of the city government, with the aid of experts called in to assist it. Its most recent report relates to the Department of Electricity, and was presented to the City Council on Oct. 31. The investigation in relation to this department was conducted by the W. H. Zimmerman Company, engineers and constructors. A summary of the portions of the report referring to street lighting follows:

BOULEVARD LIGHTING.

At present there are 177 arc lamps in the South Park system and 212 arc lamps in the West Park system which are operated and maintained by the city at its own expense. There have been many outages and complaints of poor service on the West Side, due to antiquated equipment. The commission does not see why the municipality should take upon itself the lighting of any part of the park systems, which are under State supervision. The annual cost of this service is about $25,000 a year, and this amount might well be utilized elsewhere.

GENERAL OPERATION OF THE DEPARTMENT.

In general, the commission found that the business of the Department of Electricity is well conducted. One case of the substitution of inferior coal at the H. N. May municipal plant was mentioned, however, and this indicated a lack of thorough inspection. Responsibility for the purchase of coal has now been transferred from the Department of Electricity to the Department of Public Works. The Department of Electricity recognizes the labor unions and has acceded to numerous demands and has refused others. The amount of work done by the lamp trimmers and other employees compares favorably with that done in other cities and by private corporations. All positions are filled under the civil-service laws.

STREET LIGHTING BY GAS LAMPS.

For the last few years the number of gas lamps in service has steadily decreased, due to replacement by electric arc lamps, and the time is now approaching when gas lamps will be abandoned entirely, except in the outlying districts. The gas-mantle lamps used for street lighting are rated at 60 cp each. It is not expected that this rating can be maintained always, owing to varying gas pressures, but the standard should be higher than has been revealed by inspection of lamps in various parts of the city made for the commission.

As the result of individual inspection of 956 gas-mantle lamps it was found that 60.9 per cent could be described as "good" or "fair," while the remaining 39.1 per cent fell under various classifications, as "bad," "very bad," "out," "no chimney" and "broken glass." Lamps were assumed to be "good" when the glass was clear, the mantle in good condition and the burner well regulated. Those that were classed as "fair" were accepted as passable, but still could be much improved by cleaning the glass and regulating the burner. The "very bad" lamps might as well have been left out entirely.

The reason for this unsatisfactory condition of affairs is lack of proper care on the part of lamplighters and poor inspection. Photometric field tests of the mantle lamps which could be classed as passable showed a range of candle-power from 10.6 to 41.6, the average being 24.8. It is probable that the light could be increased 50 per cent with proper care.

It is stated that the efficiency of operation of the Gas Lamp Bureau is not so high as that of other divisions in the Department of Electricity. It is remarked that should the same percentage of error which was found in one district exist in all the amount which the city is paying for gas and labor which it does not receive amounts annually to nearly $7,000. The commission recommends that the position of chief gas inspector be placed under the merit system, and says that until the gas-lighting bureau is thoroughly reorganized the city cannot hope to receive full value for the $500,000 expended in gas lighting.

GASOLINE LAMPS.

In outlying districts where electric or gas mains are not available the street lighting is done by gasoline lamps. These lamps are owned, installed and operated by the American Development Company, the city paying $26.40 per year per lamp for proper operation. Each lamp is rated at 60 cp. The commission caused a number of gasoline lamps to be tested, and the average horizontal candle-power of 20 lamps was 19.45. Later tests made when a representative of the American Development

Company was present showed an average horizontal candle-power for twelve lamps tested of 26.4. In the latter case the tests showed a great divergence, the candle-power ranging from 14 to 58.4.

The commission recommends that before the renewal of the contract with the company maintaining the lamps there be a substantial revision in the provisions of the contract. It is suggested that a variation of 25 per cent below rated candle-power be allowed. Between 45 cp and 15 cp rebates on average maintenance should be made on a sliding scale, fluctuating from 100 per cent to nothing. All lamps developing 15 cp or less should be considered as out of service, and the city should receive 100 per cent rebate for them from the first of the current month to the time of inspection.

The commission recommends that an investigation be made into the existing contract to ascertain what claim the city may enter against the American Development Company. It says: "If the results of the official tests are considered as indicative of the average conditions existing during the life of the present contract, up to July 1, 1910, the city is entitled to a rebate of 56 per cent of the cost of the contracted service, which rebate for the first ten months of the contract would amount to approximately $86,000."

ELECTRIC STREET LIGHTING.

The commission refers to the contract with the Sanitary District executed while it was making its investigations as an advantageous one for the city. By this contract the Sanitary District will take over the entire operation of the existing electric street-lighting system of 12,200 arc lamps and operate it in connection with an extension amounting to 10,000 additional street arc lamps. The commission says that the enlarged system of 22,200 lamps will be operated at a cost only about 20 per cent greater than that of the existing system of 12,200 lamps. This arrangement the commission cites as an illustration of the economy that might be effected by closer co-operation between the various public bodies expending public money in Cook County and particularly by closer co-operation with the Sanitary District in relation to the use of electric energy. The commission concludes this part of its report by saying:

"A representative or representatives of the city should be appointed to confer with representatives of the Sanitary District and of the other governing bodies interested and should draw up a plan which would reduce expenditures for electric light and power to the lowest possible terms. It seems probable that very large savings could be effected by this means, and no time should be lost in formulating plans for this purpose."

It is also recommended by the commission that a more aggressive attitude be taken by the Department of Electricity on questions relating to the gas and electric-lighting interests of the City of Chicago. It is asserted that the assumption of a firmer policy by the department in such matters would have resulted in a material saving to the city.

In an appendix the existing methods of operating the municipal street-lighting plants of the City of Chicago are considered by the W. H. Zimmerman Company. However, as during the progress of the investigation the contract with the Sanitary District already referred to was executed this part of the commission's report is no longer applicable to the city government. But it is interesting to note that in the last fifteen months the records in the office of the Department of Electricity show a total outage of seven hours and twenty-three minutes due to the failure of the Sanitary District's hydroelectric service. This total includes nine separate outages, the longest being three and a half hours, the next two and a quarter hours and the rest ranging from twenty minutes' to five minutes' duration. It is to be noted that all of the seven municipal street-lighting stations are operated by the Sanitary District's energy from the Drainage Canal hydroelectric plant. In four of the plants a standby steam reserve is maintained, and it is estimated that if this reserve steam equipment were abandoned the net annual saving would be $23,694. If all the electric equipment, as well as the steam equipment, in the four stations were abandoned—that is, substituting static transformer substations for the re-equipped motor-driven generating stations—it is estimated that the net annual saving would be $140,567. Three of the existing stations are simply static transformer stations. They have no steam reserve whatever, and it is declared that none is necessary in any of the stations. The substations to be built by the Sanitary District will all be simply transformer substations.

Electric Railway Power Difficulties in Worcester, Mass.

The Worcester (Mass.) Consolidated Street Railway Company is at present undergoing a series of drastic criticisms from the daily press on account of irregularities in its power supply, which is derived from an old steam plant located at the south end of the city about two miles from the business center. For many years the plant has borne the brunt of the Worcester service, and under the policy of the former controlling interests it was allowed to depreciate beyond a reasonable limit, little money being appropriated for its extension or improvement. The Worcester system is now one of the constituent companies of the New England Investment & Security Company, headed by Mr. L. S. Storrs, of Springfield, and the new management is pushing the construction of a large turbine plant at Millbury, six miles southeast of Worcester, from which power will be transmitted to the Consolidated system and distributed from a rotary converter substation in the center of the city. The old steam station will be utilized in peak service upon the completion of the new plant in the latter part of the coming winter. Meanwhile the present management is obliged to shoulder the troubles arising from the failure of the former owners to set aside funds for plant enlargement. The Worcester Board of Aldermen has appointed a committee of investigation and has retained Prof. Harold B. Smith, of the Worcester Polytechnic Institute, to investigate the physical and operating condition of the company.

Municipal Underground Construction in Chicago.

One of the findings of the recent report of the Merriam Commission on City Expenditures in Chicago in relation to the Department of Electricity is that in various parts of the city there is at the present time 67,258 ft. of underground conduit, representing an investment of $85,000, which is unoccupied. Further, there is 114,005 ft. of conduit, representing $140,000, which is only partially occupied in streets on which there are at present overhead circuits. Some of the underground ducts have been unoccupied for years, having been put in when new pavement was laid, and the city having lacked the funds to transfer the aerial lines underground since then. It is often the case in districts where by ordinance all wires should be underground that the city's circuits are still overhead, and two or three wires necessitate the presence of ungainly pole lines along the curb where private companies' wires are underground.

In view of the fact that the street lighting of the city is about to be taken over by the Sanitary District, supplying hydroelectric energy from the Drainage Canal and adding about 10,000 new street arc lamps, the commission recommends that further extension of underground work by the Department of Electricity be done under the most economical conditions. Generally the character of the recent construction work done by the Bureau of Electrical Construction and Maintenance of the Department of Electricity is good, but before final conclusions are made as to future work the expenditures for equipment and construction should be investigated.

Wireless Work of the Signal Corps Laboratory.

In the Signal Corps laboratory, located in the laboratory building of the Bureau of Standards, Washington, D. C., much experimental work has been accomplished in the past year. A 180-ft. antenna has been erected and the necessary equipment for carrying on such work secured. A high-frequency generator of 2 kw rating, capable of giving 100,000 cycles per second, has been installed in the basement of this building and

suitable leads provided to the experimental rooms above in close proximity to the antenna masts. The mechanical difficulties in constructing such a high-frequency generator have been finally overcome, according to Brigadier-General James Allen, chief signal officer of the United States. The attainment of this result involves the use of a rotor about 1 ft. in diameter, operative at a speed of 20,000 r.p.m. This machine produces approximately pure sine waves, which are sustained in amplitude and correspond to a wave-length of about 1.86 miles.

In addition to this, two small arc generators have been installed. They are capable of producing sustained oscillations whose frequency is from 400,000 to 500,000 per second. Due to the novel forms of apparatus required for this kind of work, many vexatious delays have occurred in securing a test of the equipment. The laboratory has now a complete wireless telephone plant working satisfactorily, with which experiments are being made.

The laboratory was organized primarily to assist in the development and design of new equipment. As soon as a new electrical instrument or device is thought to be suitable for adoption, its connection with the laboratory ends and its future production is taken up through commercial channels. The laboratory equipment has been added to considerably with the view of preparing for research work along the lines of wireless communication. The limitations of the wireless telephone and telegraph at the present time and the large potentialities of the subject indicate the desirability of further investigations.

Northwest Generating Station of Commonwealth Edison Company.

Work on the foundations of the future Northwestern station of the Commonwealth Edison Company in Chicago is now under way. The site of this station is near the corner of California Avenue and Roscoe Street, on the west bank of the North Branch of the Chicago River, and about six miles northwest of the central business district of the city. The station now building will have an ultimate rating of 120,000 kw in six units of 20,000 kw each. Two of these machines will constitute the initial equipment, and it is expected that the first one will be in service within a year. The company is the owner of a large amount of land in this site, and after the first station is built it is planned to erect a duplicate of it, of equal size, so that the total rating of the two stations when completed will be 240,000 kw.

Holabird & Roche are the architects for the new station, and Sargent & Lundy are the consulting engineers. The general contractor is the George A. Fuller Company. Other contracts have been awarded as follows: Structural steel, bridges and chimney stacks, George W. Jackson, Inc.; boilers, Babcock & Wilcox Company; coal and ash conveyors, Mead-Morrison Manufacturing Company; crane, Morgan Engineering Company; turbo-generators, General Electric Company; condensers, International Steam Pump Company (Worthington).

An important adjunct to the station is a double-track elevated railway, about 0.75 mile long, to be operated by electricity and connecting the power house with the tracks of the Chicago & Northwestern Railway. This railway, which has been carefully built, is nearing completion. The contractor who has charge of this work is James O. Heyworth.

The Importance of the Inventor's Work.

Mr. Donald M. Carter, a Chicago patent lawyer, was the speaker at the weekly luncheon of the Electric Club of Chicago on Nov. 2. His subject was "The Inventor as a Factor in Civilization." He spoke first of some of the "freak" inventors, but said that these men were nevertheless worthy of respect, as they exhibited faith in an idea not yet accomplished, and that faith is the secret of all progress. It is a mistake to ridicule the inventor as a crank. The inventors have done more for the material advancement of the human race than any other class of men; they are the most important men in civilization; indeed, civilization itself is really the result of the work of their minds and their hands. As a rule, the work of the inventor is not spectacular, and he does not receive the credit to which he is entitled, for he is the emancipator of the human race from the tyranny of things, and this is as true of the work of women as of men. The speaker drew a picture of the progress made in the necessities, comforts and luxuries of life as a result of the work of the inventor.

Few great inventions are made all at one time or by one man; they do not emerge full-fledged, so to speak, as the product of a single brain. Usually there is a step-by-step chain of development to which a number of inventors contribute. One man takes the last step and makes the thing practical, and he gets the patent. Mr. Carter cited the invention of the telephone as an example of the growth of an invention. Bell only contributed a small part. Almost literally, he simply tightened up the last screw, but he was the man who took the last step and he was legally entitled to the invention.

In the case of the aeroplane patent litigation the Wrights seem to have conceived the idea of warping the wings to preserve balance, but their claims apparently were not broad enough to cover other means of effecting the same object besides those which they described, and as a result of the preliminary injunction obtained the patent has been dissolved by the courts and other aviators are flying with aeroplanes. This case shows the importance of wording the claims so as to protect the invention properly.

Mr. Carter said that the patent system of to-day is wrong. Apparently every man's hand is raised against the inventor, and even after he has obtained his patent he has to fight strenuously to protect his rights. This ought not to be the case. The inventor ought to be encouraged in his work, for he is really the hope of the world in doing away with the drudgery of existence by utilizing the powers of Nature.

Mr. F. P. Vose, who presided, pointed out that the service which the patent lawyer rendered to the inventor was important and should not be overlooked. Senator N. Juul, of Chicago, a member of the Illinois Legislature, made a short speech, during which he said that when he was in Europe he noticed that the grave of Oersted was almost neglected, and expressed the belief that the work of this great Danish scientist in the early part of the last century had never been adequately recognized. Others who took part in the discussion briefly were Messrs. H. F. Holland, V. L. Crawford, of St. Louis, and H. A. Fife.

Governmental Electrical Control in the Transvaal.

The Transvaal government has recently passed certain legislation with regard to electricity. It is clear, in the first place, that the Legislature favors municipal trading. Thus no person except the Council of the municipality shall engage in an undertaking to supply to any other persons energy exceeding 20,000,000 kw-hours per year unless the undertaking be licensed. Undertakings existing prior to the commencement of the act may, however, be continued for one year and no longer, unless licensed under the act.

There are not many power schemes excepting the largest which fall under such a denomination, but recognition is also paid to the undertakings which are to generate less than that amount of energy per annum. It is provided in the act that if any person or company desires to carry out a private supply of electricity not exceeding 20,000,000 annual kw-hours he may obtain permission from the Governor.

It follows that anyone may enter into a public supply undertaking without being unduly interfered with so long as the permission from the Governor is obtained, and assuming always that the supply does not exceed the figure set forth in the act. Such an undertaking will not be free from ordinary legal obligations, but it is apparent that a reasonable-sized system could be constructed without statutory powers being necessary. When giving his permission for an undertaking the Gov-

ernor may insist on certain provisions being complied with. Full particulars must be given relating to the company when applying for a license, including the proposed location of sites for stations, names of owners and occupiers of the land which it is proposed to acquire, proposed sources of water, etc.

It is clear from the fact that this legislation has been found necessary that the most pressing question at the moment is the supply of electricity on a large scale. The legislation is clearly aimed at defining the position of such concerns as the Victoria Falls power supply and other similar undertakings. At the same time it should be remembered that the Transvaal is growing rapidly.

Traces of the conflict between municipal and private ownership, a conflict which is always characteristic of English legislation concerning electricity, are to be found in the act. No supply may be given in a municipal area without the consent of the municipality. Perhaps the most interesting provision in the act is that which provides that a licensee must neither carry on any other business or undertaking nor, in the generation of electric energy, use coal from any mine in which he is interested, directly or indirectly. The Governor may fix a limit to the amount of power to be generated, and if the company refuses to supply any consumer in its district, the minister must decide the charges and conditions under which the supply shall be carried out.

The price of energy may be revised at the end of seven years and afterward at intervals of three years. The reduction in the price of electricity at the end of such a period, however, is not to be less than one-half of the reduction effected during the interval in the cost of supply of power. If, therefore, a power supplier by means of a new plant or the adoption of a new system shall be able to reduce his costs of production, half of such saving must be given to the consumer.

The licensee, however, must do more than this for his consumer, as he is compelled under the act to give him 25 per cent of the surplus profits. Surplus profits are calculated after all charges have been made and interest on share capital and debentures has been provided for. Various matters in regard to price are to be referred to the minister. It is enacted that any charge to a consumer must not be reduced without first obtaining the approval of the minister. No preference can be given to a consumer without the consent of the minister for the time being.

There are various provisions by which it is possible for a license to be revoked, under which circumstances it is open to the Governor to purchase the undertaking on terms. The government may take over an undertaking after thirty-seven years upon due notice being given and upon payment of the then existing value of lands, buildings, plant, etc., but no addition is to be given for either good-will or prospective profits.

The act is to be administered by an advisory committee known as the power undertaking board; the government mining inspector is to be chairman of such board and all the members are to be officers in the railway or public services. The number of members is not to exceed five.

New System of Lighting for Atlantic City's Boardwalk.

The lighting and boardwalk committees of the City Council of Atlantic City, N. J., have under consideration a number of schemes for illuminating the city's famous Boardwalk, which at present is illuminated by enclosed-arc lamps along the outer edge of the walk and festoons of incandescent lamps suspended at right angles to the walk. Rival bidders have erected at various points on the Boardwalk working exhibits of schemes proposed by them, so that in considering their quotations the committees may have a sample of the actual installation and its effect before them. Gas and electricity both appear in the bids received, but no one seems to take the gas schemes seriously and it is doubtful if they will receive any consideration whatever.

The exhibits shown comprise tungsten standards in the center and along the edges of the walk with flaming arcs at the street intersections. The bids submitted were in part as follows: Atlantic City Electric Company—Double-arc standards, $108, $116.40, $110.20, $118.60; single-arc standards, $102, $110.50, $104.20, $112.60; intermediate ball-top standards, $81.60, $90, $85.05, $93.45; incandescent standards (five lights), $69.60, $78, $72.65, $81.05. Atlantic City Gas Company—Gas-arc lamp-

Fig. 1—Lighting Exhibition of Atlantic City Electric Company.

posts, $64; two gas-arc lamps, $20; lighting under five-year contract, dusk to midnight, $80 per post per year; dusk to dawn, $130 per post per year, company to do all renewing etc. L. L. Jones Company—Short posts, $77.50; short posts with globes, $84.50; tall posts, $124; tall posts with globes, $128.50; tall posts, style at New York Avenue, $120; tall post, same style, with globes, $124.50; flaming arcs, $55; carbon for flaming arc, $18.50. Sterling Bronze Company—Cast-iron posts, $166; cast-iron post with bronze base, $76.50; additional lamps, 10-hour Stave, $33; seventeen-hour Stave, $37.50. Elmer P. Morris Company—Arc posts, $82; incandescent intermediate posts (five lamps), $54; globes, $1.85; sockets, 40 cents; complete cost, Maryland to Missouri Avenue, $6,420. Welsbach Street Lighting Company—Erect all posts and fittings, etc., at its own expense, same to remain its property, providing it gets a seventy-five-year contract to light the Boardwalk at the following prices

Fig. 2—Tungsten Standards by Night.

per year per post (price variations according to hours of illumination and also to single, double or triple lights), $154, $100, $114, $78, $86, $62. Smyser-Royer Company—Posts, each, $63.93. Extra charge for balls according to quality, etc.

The Smyser-Royer Company has six posts spaced from 60 ft. to 40 ft. apart consuming 2970 watts per hour, or 12.38 watts per lineal foot of walk. The exhibit of the L. L. Jones Company

comprises five posts spaced approximately 45 ft. apart, consuming 7755 watts per hour, or 42.8 watts per lineal foot of walk. The Atlantic City Electric Company has two exhibitions; in one four Mott posts are spaced 60 ft. apart with one post on the inside of the walk with festoons, consuming 4140 watts per hour, or 34.5 watts per lineal foot of walk. In the second scheme there are nine Mott posts spaced 40 ft. apart with festoons, consuming 2920 watts per hour, or 11.6 watts per lineal foot of walk. The Sterling Bronze Company has three posts spaced 100 ft. apart, consuming 3120 watts per hour, or 15.6 watts per lineal foot of walk. The Elmer P. Morris Company has thirteen posts, three in the center of the walk spaced 200 ft. apart, five on the outside rail and five on the inside rail spaced approximately 100 ft. apart, consuming 4475 watts per hour, or 10 watts per lineal foot of walk. The present lighting system between Missouri and Maryland avenues consumes 13,020 watts in arc lamps and 55,080 watts in incandescent lamps.

There is much difference of opinion manifested by the public in the lighting scheme on exhibition. The owners of the large hotels along the Boardwalk object strenuously to any system of lamps and standards in the center of the walk and to any system of festoons, maintaining that the first would destroy the majestic width of the promenade and that the second has an undesirable element of cheap plasteriness about it. The hotel men are also insistent on the removal of the unsightly poles and wires from the Boardwalk, claiming that they have been promised for some time that the wires would be placed in conduit under the walk and would no longer mar the view of the ocean. Standards on the sides of the Boardwalk are favored by them.

The majority of the bidders declared that the only proper way to light the walk was through standards along its center, it being impossible to obtain the requisite effect by any other means. The Business Men's League, on the other hand, objects to the removal of the festoons with their Christmas-tree effect, claiming that the Boardwalk is a festive place and that the festoons carry out the carnival idea. The league also objects to the center standards. The electric light company, it is stated, will remove the electric light wires from the poles and place them in conduit on March 1, 1911.

Investigation of High-Tension Transmission Continued in Massachusetts.

The Massachusetts Gas & Electric Light Commission gave a continued hearing on Sept. 27 and another on Oct. 10 upon the investigation of laws and conditions bearing upon high-tension power transmission laid upon the board by Chap. 55, Resolves of 1910. At the earlier hearing Mr. Alton D. Adams, counsel for the Town of Leominster, contended that the proposed bill granting power companies the right of eminent domain riddles the power of local authorities to determine the right of transmission lines in crossing public ways and places. He also objected to the bill on the ground that the right would be exercised by companies who restricted their power markets. He did not oppose the granting of eminent-domain powers under proper control and with the provision that all persons desiring to purchase energy should be sold it by the company. Touching upon the need of cheap power in Massachusetts, Mr. Adams said that the State census of 1905 showed that the manufacturers of the commonwealth were using more than 1,000,000 hp. The actual rating of steam engines installed at that time was nearly 700,000 hp, including a small percentage of internal combustion engines. The last report of the board shows that the total rating of electric motors served by local stations in Massachusetts is practically 100,000 hp, or about one-seventh the engine capacity. The opportunity for electrical expansion would be enhanced under eminent-domain rights, given appropriate regulation and conditions. The foregoing figures did not include the engines of electric railways and electric light companies. Arguing that the so-called small manufacturer needs cheap power relatively as much as the large one, Mr. Adams showed that in 1905 there were 10,723 industrial establishments in Massachusetts, and the average power installation was 93 hp, and in 90 per cent of the establishments it was but 41 hp. Mr. Adams then argued at length that the proposed bill is unconstitutional on account of the proposed limitation of the power market.

Commissioner Schaff then urged the transmission interests to bring forward evidence that an undue expense had been thrown upon them in line locations on account of the lack of the right of eminent domain. He said that the question under the act is what impediment there is to-day, and how much is represented in capital that is due to the absence of the right of condemnation.

Mr. C. S. Davis, Boston, counsel for the Amherst Power Company, stated that Massachusetts manufacturers are coming more and more to depend upon cheap power for successful operation. Water is going to be conserved and made better use of than in the past on the rivers of the State. He cited the case of a large manufacturer in Fitchburg who had recently taken electric power, and who had become convinced that his power was costing practically nothing in comparison with the former cost of steam power, for the reason that the electric power was more constant, enabling steady running of machinery, so that production was regular and of much larger volume than with steam. A prominent cotton manufacturer also found that a very large percentage of the breakage was caused by irregularity of steam power, and that electricity increased the output of the plant to a large extent, with the same mill equipment and personnel. Mr. Davis said that he did not for a moment believe that the hydroelectric companies are going to be without State regulation. He felt that the right of eminent domain should be recommended by the board to encourage the development of the industry. He felt that the principal hazard in respect to investment in hydroelectric enterprises lies in lack of surety to reach a market. The hydroelectric companies only ask to serve such companies and persons as the board requires. Gen. Schaff remarked that if the number of power lines should be limited and the local companies compelled to buy of the transmission organizations it would simplify matters and would go a long way toward establishing the public-service character of the hydroelectric enterprise. Mr. Davis said that the companies are willing to come before the board and be regulated in regard to where their lines shall go, what lines shall be built, what prices shall be charged, and what profits made.

Mr. M. B. Jones, Boston, counsel for the New England Telephone & Telegraph Company, submitted an amendment to Chapter 122 of the Revised Laws designed to give telephone and telegraph companies the right of eminent domain substantially as outlined in the bill presented to the board by Mr. W. Rodman Peabody for the Amherst Power Company. Mr. Jones argued that the quality of service would be improved if more latitude in the location of lines was available. He said that it is becoming more and more difficult to negotiate for private rights-of-way, and he went on to cite a case where the telephone toll service of a neighboring state has been seriously impaired for several years by reason of the close proximity of high-tension power lines and long-distance telephone lines upon the same highway, and yet neither company is able to move because of its absolute inability to purchase private rights-of-way. The passage of an eminent-domain statute has at last permitted the difficulty to be removed.

At the hearing of Oct. 10 Mr. Everett W. Burdett, Boston, counsel for the Massachusetts Electric Lighting Association, the Boston & Northern and Old Colony Street Railway Companies, emphasized the present unsatisfactory state of the laws relating to pole-line locations, and agreed with Mr. Jones to present at the next hearing suggestions regarding advisable legislation. Mr. W. Rodman Peabody, for the Amherst Power Company, said that no revision of the right of location upon the highways could benefit transmission companies, as their proper place is clearly on a private right-of-way. He said that his clients are not going to take the chances of extending their lines upon the highways, and that the Amherst Power

Company recently expended a large sum of money to buy a right for two miles over private location rather than accept the offer of a location on a railroad right-of-way at a nominal rate of $5 a pole rental. Mr. Peabody promised to submit a tabulation of percentages showing the relative expenditure for land and the average price of the land where the line was actually placed. The hearing was continued to Oct. 31.

Analysis of Diversity Factors.

In a paper read at the Frontenac meeting of the Association of Edison Illuminating Companies Mr. H. B. Gear presented an analysis of the diversity factors in various parts of the distributing system of the Commonwealth Edison Company. The author defined the diversity factor as the ratio of the sum of the maxima of the subdivisions of any part of the system to the coincident maximum demand observed at the point of supply.

The observations made and results recorded for various classes of consumers are given in Table I. Group 1 represents a residence block in which there are thirty-four consumers

TABLE I.—ANALYSIS OF CUSTOMER DIVERSITY-FACTORS.

Group.	Number of Consumers.	Kw connected per Consumer.	Sum of Consumers Maxima.	Maximum of Group.	Diversity Factor.	Average Consumer Load-factor.	Group Load-factor
RESIDENCE LIGHTING.							
A.....	34	0.53	12	3.6	3.33	7.0	23.3
B.....	185	0.53	68	20	3.40	7.0	23.8
C.....	167	0.87	93	28	3.32	7.3	24.0
Average	128	0.68	57	17.2	3.35	7.1	23.9
COMMERCIAL LIGHTING.							
D.....	46	1.28	46	33	1.40	13.0	18.0
E.....	79	0.74	36	26	1.40	11.0	16.0
F.....	160	0.53	62	41	1.51	10.0	15.0
G.....	221	2.70	403	270	1.48	13.0	19.0
Average	95	0.70	48	33	1.46	10.8	15.7
GENERAL MOTOR SERVICE.							
H.....	29	.1 h.p.	30kva	21kva	1.43	15	21
I.....	18	3.3	40	25	1.60	16	26
J.....	11	11.8	90	65	1.39	18	28
K.....	25	6	100	70	1.43	21	30
Average	21	4.5	65	45	1.44	15.5	26

having a connected load of 18 kw, or an average of 0.53 kw per consumer. The sum of the consumers' maxima is 12 kw, while the actual maximum as measured at the single transformer supplying to the block is 3.6 kw; the diversity-factor is thus 3.33 between the consumers in the block. The average load-factor of the group of consumers is 7 per cent, while the load-factor of the power delivered from the transformer is 23.3 per cent.

Group B is a similar block having 185 consumers with the same average connected load. The sum of the consumers' maxima is 68 kw, the transformer maximum is 20 kw, the diversity factor is 3.4, and the group load-factor is 23.8.

The premises lighted by these two transformers were practically all apartments and the public halls of the same.

In Group C about two-thirds of the premises were small apartments and the remainder large apartments and residences. This condition accounts for the greater connected load and larger average load on this transformer. The diversity factor, however, remains practically the same as in the previous cases.

The determination of the sum of consumers' maxima in cases where the connected load is less than 1 kw was based upon averages worked out during a time when all consumers were provided with demand indicators, the values varying from 1 to 1 for one lamp to 2 to 1 for twenty lamps.

Among the commercial lighting consumers Group D represents small stores on an outlying business street, with several saloons and restaurants; in Group E there are no large stores, no saloons and no restaurants; Group F includes nine apartments above stores, and an equal number of offices, lodge halls, etc.; Group G represents 221 consumers in an office building together with the general motor service for the building. In the last group the connected load of 603 kw includes 180 hp in ventilating fans, pumps and such other machines as are used in an office building having hydraulic elevators. Since the motor load could not be measured separately, and the total given is not strictly commercial lighting, the results of Group G are not included in the average of the commercial lighting groups.

Among the general motor users Group H consists of twenty-nine single-phase consumers having a connected load of 27 hp and an average load or 1.1 hp. The sum of the consumers' maxima is 30 kva, the transformer maximum is 21 kva and the diversity-factor 1.43. The consumers are "sweat shops" manufacturing men's clothing. In Group I ten of the eighteen consumers are clothing manufacturers using single-phase motors, and the other eight are other manufacturers using three-phase motors. The largest consumer in Group J is a woodworking establishment in which the machinery operates steadily; this fact accounts for the high transformer maximum and the low diversity-factor. About fifteen of the twenty-five consumers in Group K are small clothing manufacturers, each using less than 5 hp.

Various diversity-factors of the system, in addition to those of the customers, are shown in Table II.

THE EFFECT OF DIVERSITY-FACTOR ON INVESTMENT.

By the use of the diversity-factors shown in Table II it is possible to estimate the investment required to serve each of the four classes of consumers under the conditions existing in Chicago.

Assuming that the generating plant can be installed for $100 a kilowatt of rated output, substation and transmission lines for $60 a kilowatt, feeders, mains, services, etc., at an average of $150 a kilowatt and that meters cost an average of $10 each, the investment required to serve a group of residence lighting customers is $440 per kilowatt of generating station load. Of this amount $124 is for consumers' meters, $12 for transformers, $146 for distributing lines, $58 for substation and transmission lines and $100 for generating equipment. These figures are based on an efficiency of 86 per cent from the substation bus to the consumer and an efficiency of 88 per cent for transmission and conversion, making a total full-load efficiency of approximately 75 per cent.

The author said that in scattered suburban territory the cost of distributing lines sometimes runs as high as $300 a kilowatt. In such cases the total cost for residence lighting is

TABLE II.—DIVERSITY-FACTORS OF THE SYSTEM.

	Residence Light.	Commercial Light.	Motor Service.	Large Users.
Between consumers.....	3.35	1.46	1.44	....
Between transformers.....	1.3	1.3	1.35	1.15
Between feeders.....	1.15	1.15	1.15	1.15
Between substations.....	1.1	1.1	1.1	1.10
Consumer to transformer.....	3.35	1.46	1.44	....
Consumer to feeder.....	4.36	1.90	1.95	1.15
Consumer to substation.....	5.02	2.19	2.24	1.32
Consumer to generator.....	5.52	2.41	2.46	1.45
Consumer to generator (corrected for losses).....	4.13	1.81	1.84	1.09

approximately $600 a kilowatt. In certain closely settled residence districts of Chicago, where the feeders are underground but most of the distributing mains are overhead, the investment in distributing lines is below $100 a kilowatt, making a total investment of approximately $390 per kilowatt for residence lighting.

Similar figures for commercial lighting indicate a total in-

vestment of $354 a kilowatt, of which $38 is for meter investment. With general motor users the investment is $330, of which $15 is for meter investment. For large users the investment is $215 per kilowatt and the meter cost is negligible. The figure for the large user is based upon an average cost of $50 a kilowatt on distributing lines, since such consumers are often supplied with energy over separate feeders, which are less expensive than the general feeder and main system.

The above investment costs are given in detail in Table III. The high meter investment required for residence consumers is due to the low average maximum demand and the high diversity-factor of such consumers. The demand of a group of commercial lighting consumers is nearly three times as great as that of an equal group of residence consumers and the cost of the consumers' meters is therefore spread over a larger number of kilowatts than is the case with residence consumers.

The author said that in view of the tendency of high-efficiency lamps to reduce the average consumers' demand without reducing the meter investment it would seem that the appearance of a less expensive type of meter would permit material savings to be made in that proportion of the investment which is chargeable to metering the smaller consumers. The figures further serve to emphasize the desirability of consolidating different kinds of service under similar rate schedules in order to avoid the multiplication of meters in the consumer's premises as far as possible.

TABLE III.—INVESTMENT IN DOLLARS PER KILOWATT FOR VARIOUS CONSUMERS.

	Residence Lighting.	Commerci'l Lighting.	Motor Service.	Large Users.
Meters	124	38	15	Negligible
Transformers	12	12	12	8
Distributing lines	146	146	145	49
Substation and transmission	58	58	58	58
Generating equipment	100	100	100	100
Total investment	440	354	330	215

Massachusetts Commission News.

The Massachusetts Railroad and Boston Transit Commissions, sitting as a joint board, gave a hearing on Nov. 1 upon the rapid transit situation at Boston in connection with a resolution requiring the two boards to report to the Legislature of 1911 with recommendations upon the construction of certain subway lines, the extension of existing subway leases now held by the Boston Elevated Railway Company and the consolidation of the West End Street Railway Company with the Boston Elevated. The feature of the hearing was a brilliant and candid discussion of the transit situation by Gen. William A. Bancroft, president of the Boston Elevated Railway Company, who reviewed graphically the progress made in the past twelve years, pointed out the relation of comprehensive improvements under construction or schedule for immediate completion to work accomplished in the past decade, and emphasized the need of an extension of existing subway leases before their expiration and the importance of establishing a single transportation system by legal enactment in order that the community shall receive the facilities which it requires, supplied by capital induced by favorable conditions to invest in improvements, unhampered by needless duplication of physical plant and inefficient, restrictive conditions of operation.

A strong plea was made by General Bancroft for the consolidation of the Boston Elevated and West End Street Railways. The terms of the latter's lease to the former are such that at its expiration there is required a physical separation of the systems involving serious waste and duplication of plant, as well as great public inconvenience. The company has purchased a site in East Boston located on tidewater at a cost of about $300,000, and it should know at once whether the two systems are to be operated independently or not. General Bancroft said that the stockholders of the West End company are prepared to accept consolidation on the basis of an 8 per cent dividend guarantee on second preferred and first preferred stock to be issued by the Boston Elevated in exchange for West End shares. This means an additional charge upon the company of $125,000 per year, but the unnecessary expenditures of capital and the unnecessary operating costs of separate systems would more than offset this. The Boston Elevated believes that it is a much better plan to take over the West End property on an 8 per cent basis than further to delay the consolidation. In itself the dividend rate of 8 per cent is not unreasonable.

In conclusion General Bancroft discussed the proposed subway in the West End of Boston which various interests desire built in connection with the Boston terminus of the Cambridge subway. The company does not favor this construction, which would necessitate a loop under Tremont Street through Bowdoin Square to the Charles River. The cost would be about $4,000,000 and the operating difficulties would be most trying, particularly at Scollay Square, which is the logical terminues of a loop extension of the East Boston tunnel and an important station for cars entering the city by the new East Cambridge elevated extension. The hearing was adjourned to Nov. 8 to enable other parties to be heard.

The Massachusetts Railroad Commission has issued a decision in the petition of the Selectmen of Lenox relative to fares on the Berkshire Street Railway. The board declines to order a fare reduction on inter-town traffic, but recommends that a 5-cent fare be established between Lenox and New Lenox. With respect to the service, the board recommends that before the opening of the next summer season a schedule shall be arranged to provide for more frequent trips between Lenox and the local railroad station, and in the event of the failure of the management of the company and the Selectmen to agree the board will, upon application of either party, reopen that branch of the case.

The Boston & Albany and the New York, New Haven & Hartford Railroads have filed with the joint Commission on Metropolitan Improvements, popularly known as the "Big Four," tentative studies of an electrified suburban service at Boston, in accordance with a resolution of the last Legislature. The board consists of the Massachusetts Railroad Commission, Boston Transit Commission, Metropolitan Park Commission and the Harbor and Land Commission, and is required to investigate the problem of electrification and report upon it to the Legislature of 1911 early in January with a draft of a bill providing for electrification by a fixed date. The commission is withholding the studies of the railroad companies from present publication pending their consideration by a sub-committee, but it has been learned that the study of the Boston & Albany Railroad, which is a leased property of the New York Central Lines, provides for electrification on a direct-current, third-rail basis of the main line from Boston to South Framingham, twenty-one miles west of the city, and also the elimination of the steam locomotive from the suburban loop known as the Newton-Brookline circuit. It has not been determined whether the company will erect a separate power plant of its own on tidewater or purchase electricity from the Boston Edison Company. The electrification will involve various changes in the arrangements for handling traffic, including station modifications of a minor character, the erection of additional platforms and shelters and the installation of an alternating-current signal system. The plan at present most favored is to handle the through-train service by electric locomotives and to take care of the suburban traffic by multiple-unit trains, as at New York. It is stated that the low bridges of the Boston & Albany precluded from the start any extended consideration of the use of a catenary trolley system. About 65 per cent of the Boston & Albany service from Boston to South Framingham, including the Newton circuit, is of a suburban character. With the electrification important improvements are projected in the Back Bay district of Boston, including arrangements for the handling of additional traffic on approaches to the South Station and the rejection of the plan for the use of a suburban loop subway beneath the South Station.

In connection with its investigation of the conditions and laws bearing upon the transmission of electricity in bulk in Massachusetts the Board of Gas and Electric Light Commissioners has sent an inquiry to each electric service company in the State asking for a map of any transmission lines of the company, if any are existing, which are located in, along or over land or rights-of-way owned by the company. The company owning such lines is requested to show their location, both as regards the highways or public thoroughfares and private lands, with the location of generating stations, the character of construction, whether poles, conduits or towers, and the voltage at which the current is transmitted.

The Massachusetts Gas and Electric Light Commission has issued a finding permitting the consolidation of the Uxbridge & Northbridge Electric Company, the Douglas Electric Company, the Upton Electric Company and the Millbury Electric company with the Grafton Electric Company. The Grafton company supplies electricity in the towns of Grafton and Sutton and the other four companies have their lines, respectively, in Uxbridge and Northbridge, Douglas, Upton, and Millbury, municipalities contiguous to Grafton and Sutton. All the companies are owned by the same interests. The board points out that the five properties have for some years been treated as integral parts of one system, and that a consolidation will make no change in this nor will it diminish the facilities for service. The Grafton company is to issue 2075 shares of stock to cover 394 outstanding shares of the Uxbridge company and 1681 additional shares approved by the board and seventy-five shares each for the outstanding stock of the Douglas and Upton companies. The board points out that none of the five companies has ever paid any dividends and the Grafton, Uxbridge and Millbury (Millbury Electric Company to be purchased by the Grafton company) companies have large debts. In the applications for the approval of additional stock by the Uxbridge & Northbridge Company in anticipation of the consolidation, the companies have proposed to make substantial reductions in their present debts, which the board in its approvals of such applications has required to be done, and in the event of the consolidation the aggregate amounts of the capital stock and debt respectively of the consolidating companies will be diminished and not increased. Notwithstanding such reduction in the aggregate of the individual liabilities of the companies in question, the board has already found that the fair structural value of the plants will be less than the outstanding stock and debt and has prescribed in another order the conditions and requirements by which this impairment shall be made good. The board states that it may reasonably be expected that one large company will have greater physical and financial ability than the five relatively feeble companies and that by their consolidation, with relief from the burdens incident to their large debt, substantial advantages will accrue to the municipalities served. The board has approved of the issue by the Grafton Electric Company of 425 shares of new stock at the price of $100 per share. The proceeds of 230 shares, in combination with certain assets in possession of the company designated as "mortgage notes, interest prepaid," are to be applied to the cancellation of mortgage notes for $25,000 and certain notes for $5,020, all said notes of the face value of $30,020 being thereby liquidated and canceled; the proceeds of twenty-five shares are to be applied to the payment of obligations of the Upton Electric Company, and the proceeds of 170 shares are to be applied to the purchase of the Millbury company; and of the issue of 2225 shares, of the par value of $100 each, there are to be exchanged 2075 shares for the stock of the Uxbridge & Northbridge company and seventy-five shares for the outstanding stock of the Upton company. From June 30, 1910, the Grafton Electric Company is not allowed to declare or pay dividends in excess of 4 per cent of its stock until it shall have canceled out of income not less than $30,000 of its indebtedness or expended out of income this sum for additions to its plant, or for both purposes combined. The board has also approved the issue by the Uxbridge & Northbridge Electric Company of 1681 shares of new stock to meet the cost of plant extensions.

New York Commission News.

The Public Service Commission, Second District, has announced an investigation of the telephone charges collected by the New York Telephone Company for the transmission of messages between the Borough of Manhattan and the Boroughs of Brooklyn, Queens, Bronx and Richmond, and each of them, to determine whether such tolls are unjustly discriminatory or unduly preferential or in any wise in violation of law, and as to whether or not it shall determine the just and reasonable rates and charges to be hereafter observed and in force as the maximum to be charged, and as to whether these shall be other than the rates now charged. The company is required to appear before the commission at the Engineering Societies Building, New York, on Nov. 28 and submit evidence and arguments as to the matters which are to be investigated.

The order of the commission followed resolutions adopted by the Board of Aldermen of the City of New York asking that the commission make an order fixing the tolls for all telephone calls between any part of the Borough of the Bronx and any part of the Borough of Manhattan at not more than 5 cents for each call, which action was taken upon the filing of a complaint received from the people of the East Bronx; also asking the commission to investigate the inequality in charges between the Boroughs of Manhattan and Brooklyn and order reduction of such charge to 5 cents per individual call, or such sum as would give to the New York Telephone Company proper compensation for such service, also, on the complaint of the Prospect Park South Association of Brooklyn, asking the commission to investigate the rates charged between the Boroughs of Brooklyn and Manhattan. The last-named complaint recites that the company charges 5 cents for telephone service between the Boroughs of Manhattan and the Bronx as far as Kingsbridge, Williamsbridge and Westchester, while 10 cents is charged to Brooklyn, Flatbush or Bay Ridge, and that the volume of telephone business to and from Brooklyn and numbers of subscribers therein are both greatly in excess of the business to and from the Bronx. Complaint is also made about the practice of the New York Telephone Company which provides that discounts may be allowed when messages are contracted for in quantity, and it is alleged that this is a rebate or other device which constitutes unjust discrimination.

The records have been closed in the proceeding brought against the Dwaas Electric Company, doing business at Round Lake, Saratoga County, because of the fact that it had used $3,000 derived from the sale of stock for purpose other than that authorized in the order of the commission. Since the hearing held upon this matter Harold J. Werner, president of the company, has returned to the Dwaas Electric Company and canceled in accordance with the commission's recommendation $3,000 par value of the capital stock which was paid to him for the purchase of a franchise at Round Lake.

Wisconsin Commission News.

A suit is about to be brought in court to determine the legality of the commission's interpretation of a "public utility" as defined under the Public Utilities Law. The Public Utilities Law states that the term "public utility" shall mean and embrace "every corporation, company, individual, association of individuals, their lessees, trustees or receivers appointed by any court whatsoever, and every town, village or city that may own, operate, manage or control any plant or equipment, or any part thereof within the State, for the conveyance of telephone messages or for the production, transmission, delivery or furnishing of heat, light, water or power either directly or indirectly to or for the public."

The suit was filed by the executors and trustees of the estate of E. Harrison Cawker, deceased, of Milwaukee, against the Railroad Commission. They seek to restrain the commission from enforcing upon them the provisions of the Public Utilities act, or in any manner interfering with the operation of the heat, light and power plant of the Cawker Building.

When the Cawker Building was built a steam plant was installed for the generation of heat, light and power. Later it was found that it would be impossible to make use of the full capacity of the plant and that in order to operate it with economy it would be necessary to dispose of the surplus energy. Consequently contracts were entered into with three firms whose buildings adjoined that of the plaintiff. The suit was instigated upon the commission's demand that the plaintiffs comply with the Public Utilities Law and the threatened intention of causing the Attorney-General to prosecute them in case they failed to do so. Under the provisions of the law they would be liable to a forfeit of from $100 to $1,000 a day for each day of the violation of the law.

The plaintiffs showed that they have never applied for or received a permit from the City of Milwaukee to make use of any street or alley and that they have at no time declared that they are willing to furnish power to the public or to any person other than those now being served. Notwithstanding these facts the commission regards the concern as a public utility and as such subject to all the provisions of the Public Utilities Law. The commission considers it highly improbable that the court will render a decision which is adverse to the ruling of the commission, as to do so would take away many of the benefits intended to be derived from the enforcement of the Utilities Law. Especially would it harm those larger utilities which would have to meet competition from a number of small parasitic concerns, which, if permitted to operate without regulation, would encroach upon the legitimate business of the larger concern to the latter's evident detriment.

The commission recently held a hearing in the case of the City of Sheboygan vs. the Sheboygan Railway & Electric Company. The case concerned the question of the street-lighting service furnished the city by the respondent company. Mr. Henry Detling appeared for the city and Mr. E. R. Boler for the company. Messrs. Ernest Ganzenbach and W. B. White appeared as witnesses for the electric company. The city claimed that the arc lamps furnished by the company were not giving the candle-power called for in the contract and that furthermore the cost per lamp per year was excessive. The first contention was satisfactorily disposed of at the hearing, for it developed that the lamps used were 600-watt inclosed alternating-current arcs, which represented the highest development of commercial arcs at the time of their installation. A considerable amount of evidence was introduced by the defendant to prove that at the present price per lamp—$74 per lamp per year—the company was only paying the running expenses on that part of the system properly apportioned to the street-lighting service. The commission will investigate the evidence and will determine upon a rate which will enable the company to enjoy an equitable return upon a fair valuation of its arc-lighting equipment and that portion of the entire system which should properly be apportioned to this service.

The Monroe Electric Company has petitioned the commission for authority to issue $4,000 par value of bonds and $1,200 par value of common stock. The funds to be derived from the sale are to be used in paying a floating debt incurred by reason of acquiring certain improvements and additions to its electric plant at Monroe, Wis.

Canadian Hydroelectric Commission News.

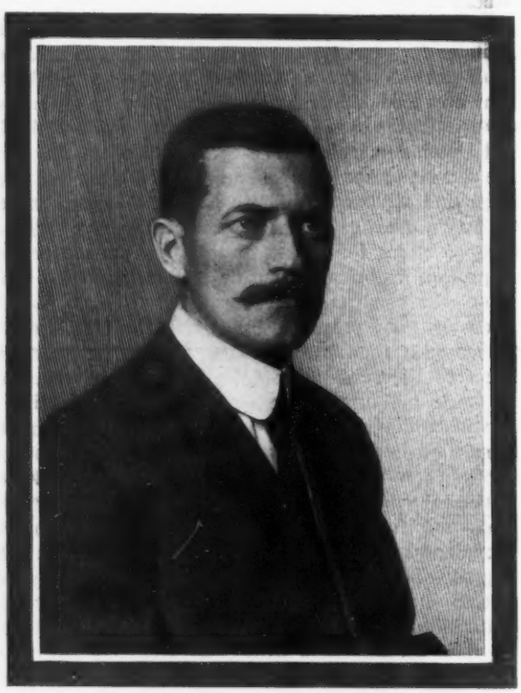
Power from Niagara Falls was turned on during the week at Guelph, which city is the second to receive power from the commission, Berlin being the first, where a celebration was held a short time ago, as reported in these columns. It is expected that power will be delivered to Toronto within the next two weeks, and that the supply will by that time have been furnished to most of the towns and cities in the municipal union. It is proposed to have a ceremony at Toronto to commemorate the delivery of power to that city.

The commission and the City Corporation of Hamilton have come to open warfare over the question of the location of the right-of-way for the commission's line in that city. Negotiations have been held at various times in the past few months with a view to the contending parties coming to some agreement for the construction of the line from Niagara Falls, but the commission has served the Council with notice that it will not construct the line over the route chosen by the city, because its own engineers have selected another route which is better. The City Council, at a special meeting on Nov. 4, refused to accept any responsibility for the proposed route, and rescinded its previous resolution giving the commission the necessary authority to build the line through the city. It is likely that some agreement will shortly be arrived at between the commission and Council.

AMERICAN ELECTRICAL ENGINEERS—XVIII.

Jens Bache-Wiig.

Jens Bache-Wiig was born in Christiania, Norway, in 1880, where he received his primary and general education, finishing the latter in 1898. One year of this period was spent in a machine shop. In the spring of 1898 he entered the Ingenieurschule of Zwickau, Saxony, from which he was graduated in the fall of 1900. He then went to the Technische Hoch-



Jens Bache-Wiig.

schule in Karlsruhe, Germany, and followed a two-year course in electrical engineering, finishing in the fall of 1902.

Upon the completion of his studies, Mr. Bache-Wiig entered the service of the Gesellschaft für Elektrische Industrie, located in Karlsruhe, working as an engineer in the designing department, and about a year later was placed in charge of this department, which position he held until the spring of 1906. During this period this company's lines of alternating-current and direct-current motors were entirely redesigned, and it was also developing various other apparatus, including transformers and controlling devices, the design of which was similarly in charge of Mr. Bache-Wiig. As of special interest may be mentioned his participation in the design of direct-current and alternating-current turbo-generators which this company developed during this period in connection with its "Electra" steam turbine.

In the spring of 1906 Mr. Bache-Wiig came to the United States and entered the power division of the engineering department of the Westinghouse Electric & Manufacturing Company at East Pittsburg, Pa. This division includes the design

of alternating-current generators, synchronous motors and rotary converters, and from the beginning of the present year he has had charge of the section including this latter class of apparatus. During the time he has been connected with the company he has taken part in the design of its standard and special alternating-current generators, motors and rotary converters. Among work of special interest with which he has been connected may be mentioned a line of high-speed, 60-cycle, 600-volt, self-starting rotary converters now on the market in sizes up to 1000 kw; the development of 25-cycle rotaries up to and including 3000 kw, this latter being probably the largest rotary so far manufactured; the development of rotaries for variable direct-current voltage, by means of direct-connected alternating-current boosters; and the development of self-starting synchronous motors for various uses, in sizes up to 4000 hp.

Mr. Bache-Wiig has made a number of contributions to the technical press and to the transactions of engineering societies, among which may be mentioned the following: "Method of Measuring and Calculating Iron Losses in Induction Motors," *Elektrotechnische Zeitschrift*, 1906; "Application of Tractional Pitch Windings to Alternating-Current Generators," *Transactions* of the American Institute of Electrical Engineers, 1908.

CURRENT NEWS AND NOTES.

Impedance Paradox.—In the numerical calculation of the variable resistance r at Z_{max}, on page 876 of our issue for Oct. 13, in a letter from Mr. H. F. Hagen discussing a certain impedance paradox the quantity 10^2 appears in the formula where 10^4 should have been used. The calculations have been made correctly, the error being wholly typographical.

Electric Lighting in Constantinople.—The Turkish Ministry of Commerce and Public Works has awarded the electric lighting concession for the European quarter of Constantinople to the Société Ganz and others, subject to the approval of the Council of Ministers. The rest of the group of concessionnaires is composed of French firms with headquarters in Paris.

Wireless Stations in East Africa.—Within the past few years wireless telegraph stations have been established at five points on the Italian Benadir coast and on the Islands of Zanzibar and Pemba. The first five stations are owned and controlled by the Italian government, the latter by the Zanzibar authorities. Additional stations are now being discussed for the mainland at Mombasa, in British East Africa, and in German East Africa.

Gas and Gasoline Street Lamp Candle-Power.—During a recent municipal investigation in Chicago it was found that 39.1 per cent of the gas-mantle lamps fell in the categories of "bad," "very bad," "out," "no chimney" and "broken glass." Photometric measurement of mantle lamps that could be classed as passable and which are rated at 60 cp showed a range from 10.6 cp to 41.6 cp, with an average of 24.8 cp. Gasoline lamps rated at 60 cp showed, on a test of twenty, an average of 19.45 horizontal cp.

Electrical Energy in Steel Works Construction.—A rather extensive use of electricity is made in the construction of the new steel works of the Minnesota Steel Company, at New Duluth, near Duluth, Minn. The works will represent an investment of $10,000,000 or more, and construction work has been under way for some time. A temporary steam-driven electric generating plant, rated at about 500 hp, has been installed, and a cement plant, hoists, derricks, conveyors, etc., are operated by motors supplied with electricity by temporary circuits. The company itself is doing the construction work.

Civil Service Examination for Mechanical and Electrical Engineer.—The United States Civil Service Commission announces the postponement to Dec. 7, 8 and 9 of an examination advertised to be held Nov. 9, 10 and 11 to secure eligibles for a vacancy in the position of inspector of mechanical and electrical engineer in the office of the Supervising Architect, in the Treasury Department at Washington, at $2,190 per annum. The duties of the position consist of inspecting and testing the mechanical and electrical equipments entering into the modern government or office building. Applicants should apply to the Washington or other office of the commission for examination form No. 1312.

Boston "Edison Life" Discontinued.—The October issue of *Edison Life* announces the discontinuance of that publication. The periodical had been sustained by the Edison Employees' Club of the Edison Electric Illuminating Company of Boston, and the announcement states that the club is not in a position financially to publish a paper to further the purposes for which it was established, namely, to be a medium of communication between the various members and the departments of the Edison company, and to arouse enthusiasm among club members. It is stated that the results have not been in accordance with the time, labor and expense involved.

Gas Companies and the "Ultra-Violet Ray."—"Beware of the ultra-violet ray" reads an advertisement in a Milwaukee paper for the new "Amber Light," a yellow-colored incandescent illuminant, which is the latest gas unit brought forward to compete with the tungsten lamp. "Most modern artificial lights owe their dazzling qualities to their ultra-violet rays," the advertisement continues, and then paradoxically remarks: "These ultra-violet rays are not visible—they are the rays that produce the chemical changes on the photographic plate. The same rays produce similar changes in the tissues of the eye. The effect is irritating and harmful. It is responsible for most of the eye-strain troubles," etc.

Inspection of Electric Meters in Chicago.—A recent report of the Merriam Commission on City Expenditures in Chicago notes that no appropriation has been made for the purpose of operating a bureau of inspection for consumers' electric meters created by the City Council. Consequently the ordinance creating the proposed bureau remains wholly inoperative and there is no officer charged with the duties imposed upon the bureau by the ordinance. Mr. William Carroll, the city electrician, has said that he does not believe it necessary to have such a meter inspection bureau, although he has included a recommendation for an appropriation for it in his departmental estimates because of the action of the City Council.

Advertising Ozonizers.—Within the last year or so there has been a notable increase in the amount of advertising of electrical appliances in daily newspapers and popular magazines. Lamps, fixtures, motors, batteries, electric vehicles, washing machines, electric flatirons, low-voltage transformers, electric toys and other electrical apparatus are advertised in periodicals of general circulation. A late addition to this list is the ozonizer. A recent cartoon in a Chicago daily represented children in a schoolroom drooping from the influence of a nebulous adversary labeled "Foul Air." The artist asked the question, "Cannot modern science banish the specter?" A maker of ozone machines promptly reproduced the picture and answered "Yes" in an effective "ad."

Number of Fire-Alarm Boxes on a Circuit.—A recent independent investigation showed that the fire-alarm and police-telegraph systems in Chicago are maintained in an efficient condition. The practice of the Department of Electricity, which has this service in charge, is to maintain about thirty alarm boxes on each circuit and so arranged that there is no danger of two boxes on the same circuit being "struck" for the same fire, thus interfering with the alarm. It has been possible to adhere to this rule generally, but in some cases the number of boxes has been greatly increased, up to as high as seventy on a circuit nearly thirty miles long. It has been recommended that the system should be subdivided thoroughly to keep down the number of boxes on a circuit and the length of circuits.

Nobel Prize for Physics.—The Nobel physics prize has been awarded to Prof. Van der Waals, who has been connected with the Amsterdam University since 1877.

Next N. E. L. A. Convention.—Though no definite decision has yet been announced, it is probable that the 1911 convention of the National Electric Light Association will be held in New York City. The Hotel Astor and the Engineering Societies' Building have been suggested as headquarters, and the exhibit feature may be omitted next year.

Proposed Illinois River Waterway.—A dispatch from Washington, D. C., states that the deep waterway plan for the Illinois River favored by Governor Deneen, of Illinois, is reported to be feasible by the board of government engineers appointed to study the subject. This plan contemplates a 9-ft. channel and the development of the incidental water-power, which is expected to yield a large revenue. While the board indicates a preference for the Deneen plant it is said to be unable to report to Congress any method of co-operation between the Federal government and the State of Illinois in relation to joint construction of the waterway. As a result, it is not likely that the aid of the national government can be procured until the next Congress meets a year from next month.

North Shore Electric Company Branch of N. E. L. A. Elects Officers.—At its first meeting of the present season, held Friday evening, Nov. 4, the North Shore Electric Company (Chicago) branch of the National Electric Light Association elected officers for the ensuing year. Mr. C. W. Pen Dell was chosen chairman; Mr. H. L. Judd, vice-chairman; Mr. E. G. Schuettge, secretary, and Mr. F. B. Minard, treasurer. A board of control was appointed, comprising, together with the newly elected officers, Mr. J. S. Reesman, the retiring chairman; Mr. A. B. Fitzgerald and Mr. A. Alsaker. Following the business session and the hearing of reports from the various officers and committees the branch members took up the discussion of technical questions propounded in the October issue of the N. E. L. A. Bulletin. The present membership of the North Short Electric Company branch is 106, approximately half of whom were present at the November meeting.

Formation of Sleet on Aluminum Lines.—An engineer who has had an opportunity to compare the behavior of both aluminum and copper transmission lines during severe sleet storms in the northern-border states declares as his experience that, in spite of the larger diameter of the aluminum conductors and their consequently greater surface area on which to collect heavy loads of ice, aluminum transmission lines have come through the heaviest storms without injury, while copper lines suffered badly from the weight and windage of their icy envelopes. The explanation given for this tendency of aluminum to avoid collecting sleet is based on the surface coat of aluminum hydroxide which gives the metal its oily appearance and feeling. Water which strikes the aluminum wire thus does not "wet" the surface and so does not adhere long enough to be frozen into sleet.

Baltimore Telegraph Service Partly Disabled by Early Snowstorm.—Baltimore experienced a snowstorm last Thursday night which lasted over the next day. Although the snow was not heavy, the velocity of the wind was such as to make it appear for a short time that a blizzard was imminent. As a result the Postal Telegraph Company was cut off from communication with New York except by roundabout methods from 9 o'clock until midnight. Another effect of the storm was an informal "quiz" class at the Johns Hopkins University on all of the lectures that had been conducted up to that time by the Illuminating Engineering Society. Only two lectures instead of the usual three were given at the university last Thursday, as it had been planned to have the visiting light scientists attend the aviation meet. The storm prevented the carrying out of the original plan and the "quiz" class was held during the time that the third lecture would have taken place.

Municipal Regulation of Central Station Rates.—The Board of Public Words, of Indianapolis, Ind., has taken under advisement a petition to compel the Indianapolis Light & Heat Company to publish a schedule of classified rates with a view to prevent discrimination. The company's attorney contends that the board had no authority whatever on the question of what rates the company should charge, so long as it did not exceed the maximum rates of 10 cents per kw-hour prescribed by the franchise. He denied that there were discriminations; that the company is governed in its rates by certain conditions, such as distance from plant, amount of consumption, minimum monthly charges and time of service in making special contracts. It was asserted by the petitioners that the ground floor of the Newton Claypool Building has a 6-cent rate, with no minimum monthly charge; that on the second floor 9⅜ cents is charged and on the third floor 12½ cents, including renewals. The city legal department gave the board an opinion that it could require the company to file a classification of rates and that the board would have the right to disapprove the schedule if deemed unfair.

Mechanical and Dielectric Strains in High-Tension Porcelain.—The relation between mechanical and electrical strains in insulators for high-tension lines has been realized sufficiently to cause the insertion of clauses in many insulator specifications requiring that the application of the test potential be made while the insulator is subjected to its rated mechanical stresses, just as if it were supporting a line-wire span. Good evidence of the fact that insulating material, such as porcelain, will break down electrically much more readily when under mechanical strain was afforded by the experience of a Western hydroelectric company which had great trouble with its high-tension entries where the transmission lines were brought through tubes at the centers of circular insulating disks. These tubes were fastened rigidly to the supporting disks, and at frequent intervals, whenever line conditions passed slightly beyond the normal, the tubes would be shattered with a loud report. Realizing that with the construction used any movement of the wires in the wind outside caused strains in the insulator tubes, it was decided to mount the tubes loosely in the supporting disks so that they would be free to move slightly with the wires. After this slight change was made the entry-insulator trouble, which had become really serious, entirely disappeared.

Modern Uses for the Telautograph.—Although by no means a new device in principle, the telautograph, invented by Elisha Gray about twenty years ago and since greatly improved, continually finds new, useful applications in modern life. A number of New York banks have these instruments installed in their tellers' cages for communicating with the book-keepers in certifying checks presented for payment. If the teller is in doubt of the balance standing to the credit of the account on which the check is drawn he picks up the telautograph stylus, unknown to the customer, writes the name of the depositor, which is reproduced in the book-keeping department, and at once receives the amount of the balance. The protective value of the device for this purpose is fully appreciated by banks where book-keepers are separated from the tellers' cages, perhaps at some distance. Several Chicago clubs, among them the University Club and the Chicago Athletic Club, have installed telautographs for "paging" purposes. The first has twenty instruments and the latter eight, located in the various floors and rooms. When a member is called for his name is reproduced on the roll of each machine, and the attendant in the room can quickly observe if the member called is in his department. In this way any member summoned can be located within two or three minutes without confusion or embarrassment through the calling of names.

RECONSTRUCTION WORK IN SALT LAKE CITY.

Improvements and Additions to the System of the Utah Light & Railway Company, of Salt Lake City.

THE property of the Utah Light & Railway Company, of Salt Lake City, has been undergoing thoroughly systematic rehabilitation and extensive improvements since control passed to the Harriman interests about four years ago. The change in ownership took place soon after the City Council of Salt Lake City had granted the company a fifty-year franchise, and, although some of the improvements are conditional upon the existence of the franchise, most of them have been made with a full realization of the necessity of placing the system in excellent condition, with a view, of course, to the ultimate return on the investment. That this return will not be brought about for several years is indicated by the large sums which have been expended in the past three years and which have been estimated for improvements now under way and in contemplation. With an expenditure of nearly a million for the reconstruction of the underground and railway plant, about a half million for a new steam station and one and a half millions for improvements and additions to its generating system, it can readily be seen that Salt Lake City is receiving the direct benefit of large expenditures which will not bring any return to the investors for many years.

After the new interests took control it was found that the most pressing needs were for the railway system and the distributing system. The first and second years were accordingly devoted to general reconstruction along a carefully worked out plan. The track of the railway system was rebuilt to the extent of about 80 per cent of the mileage, in the central district the old center-pole type of construction was replaced with side-pole span construction, feeders were placed underground, new rolling stock was added, extensions were made to the track, and modern car houses and shops were built on a ten-acre tract in the northeast portion of the city. The improvements in the distributing system have consisted principally in placing the system underground and they are described in some detail below.

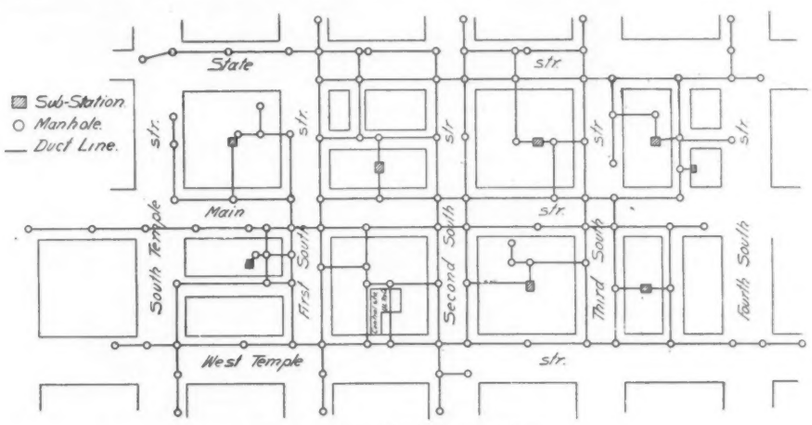


Fig. 1—Map of Conduit System.

The year 1910 is popularly known by the officials of the company as the "power year," the work of the year including the beginning of a large new central steam reserve station in Salt Lake City, the construction of a new water-power plant on the Weber River and general improvements in the transmission system.

CONSTRUCTION OF UNDERGROUND SYSTEM.

Under the terms of the new franchise the Utah Light & Railway Company was required to remove all pole lines on streets in the commercial district and to operate its distribution systems through underground conduits within the limits of the district. Consideration was at first given to the customary method of construction for cities the size of Salt Lake City, by means of underground vaults in the streets with junction boxes, connecting conduits, etc. However, a condition exists in Salt Lake City which is peculiar and which required special consideration. This condition is due to the exceptional width of the streets, 132 ft., and the unusual length of the blocks, they being 660 ft. from curb to curb, or 792 ft. from street center to street center. There are approximately seven blocks to the mile and each block is ten acres in area.

After plans had been practically worked out for the usual vault construction and after the principal Eastern cities had been visited in order to profit by their experiences, Mr. O. H. Honnold, electrical engineer for the company, devised a scheme which seemed to solve the principal difficulties. His ideas were carefully worked out by the company's engineers and, the advantages being so apparent, the plan was adopted in its entirety.

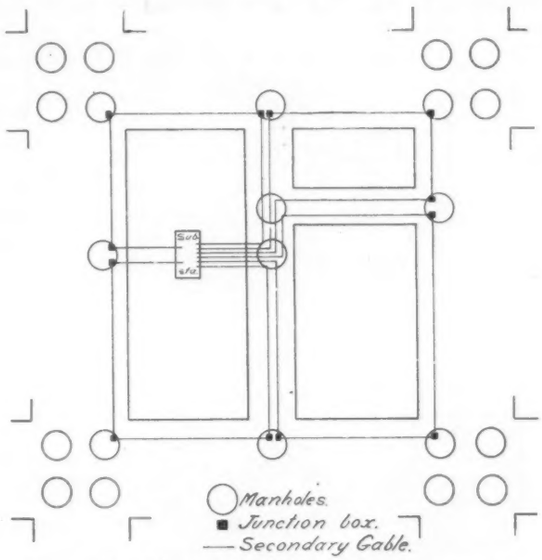


Fig. 2—Map Showing Secondary Cable Ring Circuits.

The system, in brief, consists in doing away with the underground vaults and manholes and placing all the transformers and switching apparatus in substations located in the interiors of the blocks. Double lines of conduits were installed on each street. Radiating from each station were laid four duct lines connecting with the adjacent streets at the nearest points through manholes. This construction eliminated the necessity for large manholes and subway-type transformers. The duct lines are located 4 ft. from the curb of the street and are cross-connected at street intersections. The system handles alternating-current motor and arc circuits and direct-current three-wire and railway circuits.

An outline map of the conduit system is shown in Fig. 1, the substations, manholes and duct lines being indicated in the eight central blocks in which the system has thus far been installed. Theoretically, the idea was to locate the substations in the centers of the blocks, but on account of existing buildings or property interests it was not always possible to do this. Sites were chosen as near the geographical center of the blocks as possible, and where practicable on alleyways or courts.

The construction of the conduit system was begun in the summer of 1907 and up to date the company has installed approximately five miles of conduit, or fifty miles of single-duct line. It is composed of bituminized fiber ducts laid in concrete. The joints are of the male and female type, connected by means of hot asphaltum, thus making the ducts practically water-tight. An inch spacing left between ducts is filled with fine concrete, and strength and protection are provided by an outside covering of about 3 in. of coarse concrete.

The manholes and service holes are built with brick walls, and

floor and roof of concrete, the latter being reinforced. Cast-iron manhole heads and covers are provided. The manholes are of various sizes and shapes, being square, rectangular and elliptical and varying in depth from 4 ft. to 20 ft. to conform to the condition of the duct lines. The service hole covers are watertight, though the manhole covers are perforated with 1-in. holes for ventilation. Sumps for drainage are provided in the bottoms of all manholes and service holes. These do not afford

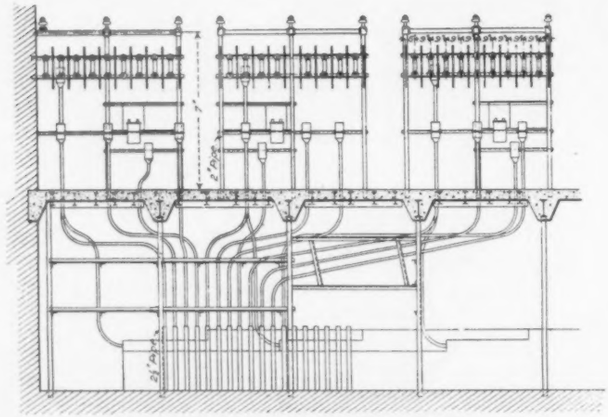


Fig. 3—Fuse Rack, West Temple Station.

sufficient drainage, however, because of the large quantity of water entering during street flushing. The city ordinance forbids sewer connections.

Paper-insulated, lead-covered cable has been adopted as standard for conduit lines. Approximately forty miles of various kinds and sizes of lead cable are in operation.

The secondary cables are 1/0, 3/0, 4/0 and 250,000 circ. mil in size, three-conductor and insulated with 1/8-in. paper for 240-volt potential. The secondary cables are tied together in ring form where possible and connected directly to the secondary busbars in the substations of each block. Wherever it was convenient to install the necessary duct lines, the blocks were divided into quarters, making four independent secondary rings radiating from the substation. These rings or individual circuits may be bused or connected together at the quarter points or corners, or separate blocks may be tied in through conductors at street intersections. Fig. 2 shows a typical block with the four secondary cable-ring circuits entering at the substation and arranged for interconnection midway between street intersections.

Junction boxes are installed at all corner manholes of the secondary ring circuits to facilitate connecting two or more cables together and to aid in disconnecting any cable from circuit in case of a breakdown on the cable. It can readily be seen that this is a very flexible and advantageous arrangement, as practically any portion of a cable can very readily be isolated in case of trouble. Furthermore, it permits the two circuits carrying the lightest loads to be thrown in together on one phase at the substation, each of the two other circuits being carried on a separate phase, thus balancing the load.

Service cables are connected through lead sleeve joints to the secondary cables and three-pole enclosed-type service boxes are interposed between the lead service cable and the customer's main to protect the cable in case of short-circuits on the customer's wiring. No great amount of expense was necessary in changing the service connections to the underground system, as the company long ago foresaw that underground conduits would have to be installed and for many years had made all service connections underground from the street poles.

For the railway feeder system there are used 500,000-circ. mil, 750,000-circ. mil, 1,000,000-circ. mil and 1,500,000-circ. mil single-conductor cables insulated with 5/32 in. paper for 600 volts. Separate cables are provided for each railway section and the system is so arranged by means of terminal boxes on the trolley poles that the overhead lines can at different points be interconnected by the use of copper connectors, thus making it possible to cut out of circuit any cable becoming damaged and needing repairs.

The direct-current 250-500-volt system is divided into six separate circuits with 500,000-circ. mil and 300,000-circ. mil single-conductor feeders, and 2/0 and No. 2 duplex lateral cables insulated with 5/32-in. paper for 500 volts potential. The secondary ground is used for the neutral on the direct-current circuit. It is tied in with the copper railway return cables at frequent points to afford ample carrying capacity for the unbalanced load. Enclosed-fuse type junction boxes are interposed between mains and laterals for protection to the mains in case of breakdown on the lateral cables or services. All service cables are joined to main or branch cables by means of lead sleeves and connected to enclosed-fuse service boxes on the customer's premises.

Series arc circuits, both for the residence section and for the commercial district, are fed through the underground system from the central station by means of duplex and quadruplex cables. These cables consist of two or four No. 6 wires insulated with 8/64-in. paper for a working pressure of 5000 volts. The arcs are of the luminous type and have proven very satisfactory. The lamps hang on ornamental goose-neck brackets at the top of the steel tubular trolley poles. In the principal business streets four arcs are located in each block, and in less important streets three or two arcs. There are eighty-five arcs in the commercial district and eight circuits in the residence section.

The primary cables leading from the central station to the substations are of No. 4, No. 2, 3/0 and 250,000-circ. mil sizes, three-conductor, insulated with 4/32-in. and 3/32-in. paper for 4000-volt potential. Each substation is direct-connected with the central station through an oil switch by a separate primary cable, which is protected by expulsion-type fuses on the primary bus-rack in the main station. Fig. 3 illustrates the fuse-rack in the central, or West Temple, station.

Duplicate primary cables have been installed with one tap to each substation. These are carried through different streets and are intended for emergency connection should the primary cable be damaged or the circuit interrupted. Fig. 4 gives a plan of the primary cable distribution. Each duplicate primary cable is operated alive and thrown into circuit with an oil switch in the substation. This switch is normally left open. Fig. 5 is an interior view of one of the substations showing the primary cable, oil switch and one of the large-size lighting transformers.

Energy for the railway lines and the commercial district cir-

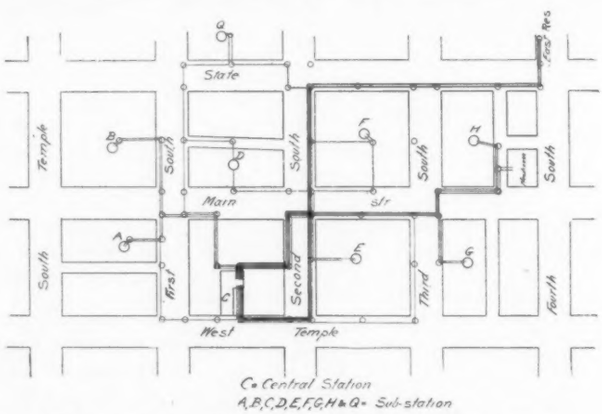


Fig. 4—Showing Primary Cables, Underground System.

cuits is brought at 4000 volts from the company's Jordan River substation to the West Temple Street central station by means of six 250,000-circ. mil cables, the lines being carried on First South and Second South Streets.

SUBSTATIONS.

There are at present nine transformer substations and one subway vault connected with the underground system in Salt Lake City. The buildings are built with brick walls, reinforced

concrete roofs and concrete floors and cable pits, and are, therefore, practically fireproof. Special attention has been paid to the ventilation of each building. This is accomplished through registers in the walls near the floor and a galvanized-iron ventilator on the roof. Windows have been installed wherever they were needed. The buildings vary in size from 8 ft. x 14 ft. to 12 ft. x 18 ft. Fig. 6 illustrates one of the substations and shows the connection to overhead motor circuits for distribution in the interior of the block.

The equipment of each substation consists of separate transformers for lamp and motor circuits, oil switches, secondary bus-rack and the necessary attachments. The transformers for lamp circuits are of two sizes, 125 kw and 50 kw, with the exception of the two at the Oregon Short Line depot vault, which are of the 40-kw subway type. The transformers are wound for a primary tension of 4000 volts and for 120-240 volts on the secondary, and are connected in multiple on both primary and secondary sides. The secondary leads are tied solidly to the secondary busbars, while the primary taps are connected through Westinghouse open-type 4500-volt fuses to the primary bus for protecting the transformers and cables against short-circuits on the secondary cables. Fig. 7 shows these secondary busbars with the open-type primary fuses and one of the transformers for lighting loads. It has been found from experience in Salt Lake City that, unless the transformers are working very nearly up to their fused capacity, a secondary short-circuit will burn itself free before blowing the primary fuse and interrupting the circuit. The transformer installations for motor circuits are of the pole type, as shown at the right in Fig. 8. They are connected "star" or "delta" on the secondary side and operate on the overhead lines in the interior of the blocks.

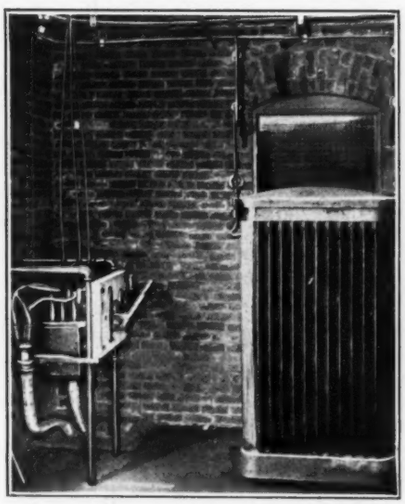


Fig. 5—Interior of Substation. Primary Cable, Oil Switch and Lighting Transformer.

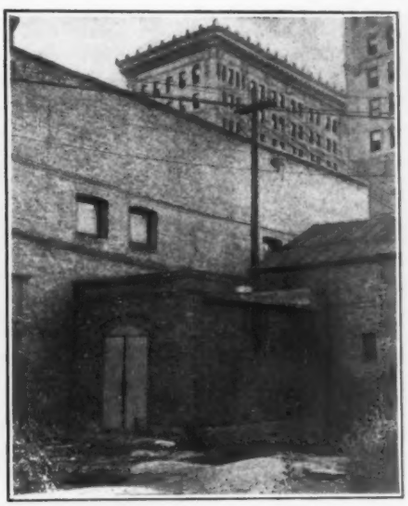


Fig. 6—Substation and Connection to Overhead Circuits.

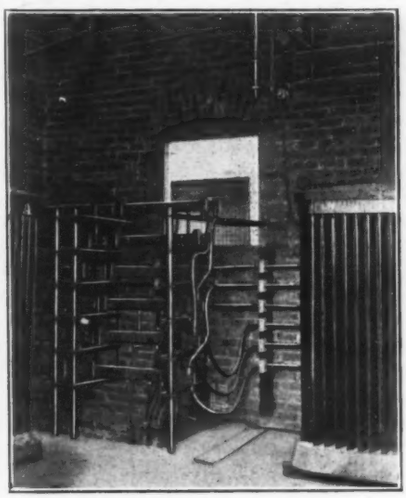


Fig. 7—Secondary Busbars with Open-Type Primary Fuses and Lighting Transformer.

The present connected transformer capacity in the substations is 2400 kw, while the total load on the underground system is 3000 kw. The underground portion of the system has been installed to take care of an increase of 50 per cent over the present connected load, while the secondary cables and stations are big enough to provide for four times the present capacity. The cost of the first eight substations was approximately $325,000.

Electricity was first turned on the cables about Nov. 1, 1908, and the system has been in continuous operation since without breakdown due to defective cables or joints. The transformers are fused for about 80 per cent to 90 per cent overload to minimize interruptions to service due to temporary overload or blow-outs, though they are amply protected against secondary short-circuits.

All primary, arc and railway cables are well bonded to the negative railway bus at the central station, while the secondary cables of each block are bonded to primary cables at the nearest point to the central station so as to afford an unbroken path for all stray railway currents that may be picked up by the lead cables. Tests were made to ascertain how much railway current was returning on lead cables, and it was found that a considerable quantity was flowing without heating the lead sheathing or having any apparent electrolytic action.

As has been just mentioned, the results from operation by means of these transformer substations have been remarkably satisfactory. Although the great length of duct necessary to make connections from the streets to the substations in the interior of each block, together with the cost of the buildings, has made the first cost of the system rather high, this disadvantage has been entirely overbalanced by the many advantages gained. The large-size vaults necessary for housing subway transformers have been entirely eliminated, together with the inconvenience of getting into them and the expense of their maintenance. The liability to interruption of service due to breakdowns of transformers on account of flood waters is prevented by placing them in dry, well-ventilated substations that are readily accessible at all times. The use of large-size transformers with ample radiating surfaces makes it possible to reduce the core losses to a minimum, an item in itself of no small moment. Safety to the attendant and ease of operation are obtained by having all transformers above ground and the primary connections well insulated. Owing to the fact that the blocks cover such large areas, many warehouses and small manufacturing establishments are located in the interiors of the blocks in the rear of the store buildings. All of these are easily accessible from the substation, affording short, inexpensive service connections.

All of the underground work was planned and carried out under the supervision of Mr. O. A. Honnold, electrical engineer; Mr. W. M. Scott, superintendent of electric lines and service, and Mr. C. H. Jenkins, assistant superintendent of electric lines and service.

IMPROVEMENTS AND ADDITIONS TO GENERATING SYSTEM.

As already indicated, about a year ago the Utah Light & Railway Company began to direct its attention to the improvement of the extensive existing generating system and the addition of new plants to keep pace with the growth of the distributing system and the consequent demand for electricity. The generating system of the company includes both steam and hydroelectric plants, the latter being located at different points in the Wasatch Mountain east of the city. There are two plants in the Cottonwood Canyon, sixteen miles southeast of Salt Lake City, with a combined capacity of 6000 hp, while 5000 hp additional is available at the Pioneer plant at the mouth of Ogden Canyon, thirty-seven miles northeast of the city. A 1750-hp reserve steam plant is located at the Jordan River station in Salt Lake City, while energy is purchased from the transmis-

sion system of the Telluride Power Company and from the plant of the Utah-Idaho Sugar Company, located in Bear River Canyon, eighty-five miles north of the city. The switching of lines from these several sources and the synchronizing of the company's water-power plants are controlled from a main receiving station at the Jordan plant in Salt Lake City equipped with water-cooled transformers and oil-break, high-tension switches. Nine water-power and three steam stations are handled from this switching station.

The company has just completed at Devil's Gate, on the

Fig. 8—Pole-Type Transformers Feeding Motor Circuit and Lighting Transformer.

Weber River, twelve miles southeast of Ogden and about thirty miles northeast of Salt Lake City, a 4000-hp hydroelectric plant to meet the increasing demand for service. The plant uses the water from the river by means of an overflow, reinforced-concrete dam located about three miles from the mouth of the canyon. The dam has a spillway 65 ft. long at the crest and rises 14 ft. above the bed of the stream, the total average height to bedrock being about 20 ft. The end abutments provide for an overflow 4 ft. deep. A row of eleven 5-ft. circular openings through the base of the dam, controlled by wicket gates, provides for additional waste flow. At one end of the dam is a fishway and at the other is the intake, which is 20 ft. in width and leads into a 7-ft. concrete conduit. The dam creates a pond about half a mile in length, which is as large as could be installed, because the right-of-way of the Union Pacific Railroad Company's main line follows the canyon at this point and, of course, could not be encroached upon. The reservoir provides a storage for three or four hours' run. The intake is controlled by an 8-ft. vertical-stem steel wicket gate.

The concrete conduit conveys the water down the canyon 2000 ft., where connection is made with a 74-in. wooden-stave pipe that continues 7075 ft. to the pressure main of the power house. The concrete pipe has a shell 9 in. thick, reinforced with 4-in. mesh American Steel & Wire Company's woven-wire fabric, and is designed for pressures of 5 lb. to 9 lb. per square inch. At one point the conduit crosses under the railroad right-of-way by means of a reinforced concrete culvert, 191 ft. long and of massive construction.

The wooden-stave pipe is built of 3-in. x 6-in. yellow fir staves according to customary Western practice, the bands consisting of ⅝-in. and ¾-in. mild-steel round rods, spaced on 3-in. centers. Near its upstream end the pipe is carried across the river on a 7.5 per cent grade on a 99-ft. span-riveted steel truss, the pipe resting in steel cradles at each panel point. For the greater part of its length the pipe is laid in a trench, it being subject to a static head ranging from 9 lb. to 77 lb. per square inch. At the power house the wooden pipe empties into a double-riveted steel pipe, 75 ft. in length, which connects directly with the water-wheel in the power house.

The power house is a one-story brick structure (Figs. 9 and 10) 56 ft. wide by 76 ft. long, the generator-room being 33 ft. wide, extending the length of the building. The generating unit consists of a Francis impulse turbine, built by the Pelton Water-Wheel Company, of San Francisco, direct-connected to a 2300-volt, 2500-kw, 60-cycle, three-phase Western Electric alternator. The water-wheel is designed to develop 5000 hp at full-gate opening, with an efficiency of 81 per cent, and operates under an effective head of 135 ft. A Pelton governor belted to the shaft of the unit regulates the supply of water to the turbine. A bank of four Westinghouse oil-cooled 875-kva transformers is used to step-up the potential to 46,000 volts for transmission. General Electric lightning arresters of the electrolytic type and Pacific Electric high-tension switches are used.

The transmission line, built specially for this plant, is of steel-tower construction, carrying two circuits, and is four and one-half miles in length to the point of juncture with the main Ogden-Salt Lake transmission line. It carries No. 1 solid, hard-drawn copper wire, with a 5/16-in., 6000-lb. standard galvanized ground wire over each circuit and grounded at each tower. At the main line junction disconnecting switches are installed, while at the station similar open-air disconnecting switches are installed, supplementing the oil switches.

In order to have reserve capacity sufficient to provide against breakdowns in the water-power system the company is now building in Salt Lake City a thoroughly modern steam station. Every Western city which is largely dependent upon hydroelectric plants for its principal supply has been forced to install a large steam (or gas-engine) station near the center of distribution to provide for the contingencies of breakdowns that so frequently are caused by storms. This has been the experience in the cities of Los Angeles, San Francisco, Portland and Seattle.

In Utah there have been times, during an east-wind storm, when all the transmission systems centering in Salt Lake City have been put out of service and when it has taken several hours before connections could be restored. It is evident that such emergencies must be provided for, and it is planned that the new station in Salt Lake City will be capable of taking care of the main part of the load, that is, the railway and commercial load, when called upon to do so.

The new station is located at the Jordan River substation, where ample condensing water can be obtained. It will be built on the unit plan, the first structure having a capacity of 10,000 hp. The building will have a steel frame, supplied by the Des Moines Bridge Company, and will rest on a pile and concrete foundation. About 1500 piles, averaging 36 ft. in length, are now being driven for the foundation. A concrete slab 4 ft. in

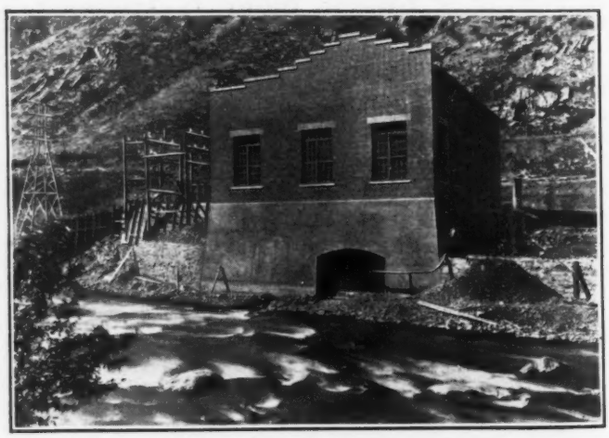


Fig. 9—Devil's Gate Power House and Transmission Line.

thickness will cap the piles and serve as foundation for the machinery. The building will be fireproof in every particular and will present an attractive appearance, red pressed brick being used for the walls, with concrete caps and sills for windows and openings.

The first unit installed will be a Westinghouse horizontal steam turbo-generator having a normal rating of 6800 kw with a 25 per cent overload rating for twenty-four hours and 50 per cent overload for one hour. The boiler equipment will consist

of six 600-hp Stirling water-tube boilers, fed by overhead coal bunkers through gravity chutes and equipped with Roney automatic stokers. The condensing apparatus will be of the Le Blanc type. Coal and ash conveyors will be installed, and other modern devices, so that the station will be a model one. A feature of the plant will be the stack, 225 ft. high., 11 ft. 6 in. in diameter at the top, and built of Kellogg radial brick. A sign reading "Utah Light & Railway Company" on the city side will be worked in with black brick. The sign will be 118 ft. from the ground, formed of letters 4 ft. high, and it will be possible to read it from Fort Douglas, several miles distant, on the opposite side of the city.

The station will have a bench-board control, a storage battery being provided for electrically operating all switches, relays, etc. It is expected ultimately to control all outgoing lines from the new station. The present switching station, which adjoins the new building, now controls all the low-tension and high-tension incoming lines.

The lines coming in from the water-power plants are sectionalized and each section of load is controlled from a bench-control board. In case of trouble on the lines, in nine cases out of ten, it is possible to trip out the bad section and avoid any effect on the distributing system other than a flicker in the light. This arrangement is, of course, particularly valuable in stormy weather. The new steam plant will be synchronized with the rest of the system and will be connected so as to take up the load automatically in case any part or all of the transmission system is cut out. For the present the 750-kw reciprocating-engine unit and the 1000-kw turbine unit forming the original steam reserve plant will be continued in service.

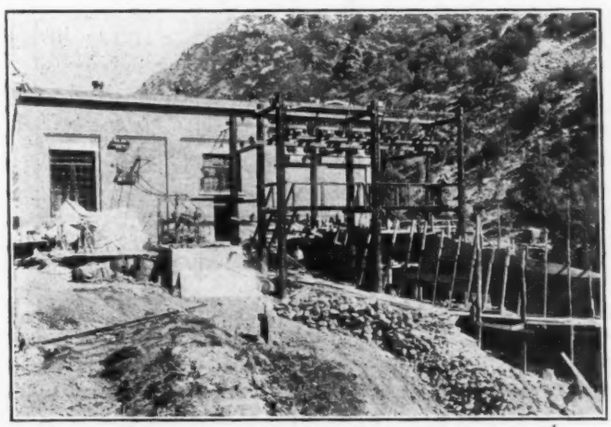


Fig. 10—Devil's Gate Power House.

It is planned to have the new station in operation by March 1, 1911; the turbine unit to be ready about Feb. 1. The station has been designed by the engineering department of Messrs. Westinghouse, Church, Kerr & Company, in conjunction with the engineers of the Utah Light & Railway Company. It is being erected by the former company, Mr. R. W. Stovell being the engineer in charge, with Mr. H. A. Brinkerhoff as resident engineer and Mr. O. A. Honnold, electrical engineer of the Utah Light & Railway Company, in direct supervision of the work.

STEEL-TOWER TRANSMISSION LINE.

The third important improvement or addition to the generating system of the company is a new steel-tower transmission line which is now being installed between the Ogden plant and Salt Lake City. This line will be thirty-seven miles long and will carry two three-phase circuits of No. 0 seven-strand hard-drawn copper. Ohio Brass Company suspension-type insulators will be used with two units in suspension for the straight runs and three units at strain points. The line will be operated at 45,000 volts. A No. 4 steel telephone circuit will be carried below the transmission circuits, while above each of the latter will be installed a 5/16-in., 6000-lb., stranded, galvanized-iron ground wire. The advantage of a wire of this nature, grounded at each pole or tower, has been very frequently demonstrated on the Utah transmission lines.

The steel towers are of the Riter-Conley type, 65 ft. high above the ground. The height to the lowest wire is 45 ft. and the cross-arms are spaced 5 ft. apart, the three wires of each circuit being carried in a vertical plane without transposition, with a 12-ft. distance between circuits. The ground wires are 5 ft. above the top transmission wires. The towers are spaced 600 ft. apart. The first tower at the power-house end is shown at the left in Fig. 9.

The company is now remodeling the switching apparatus along the Ogden-Salt Lake transmission line, putting in new 45,000-volt oil switches and electrolytic-type lightning arresters at the Pioneer and Jordan plants preparatory to raising the voltage to 45,000 volts when the change is made from the present wooden-pole line to the new steel-tower line. New oil-insulated, water-cooled transformers are being installed at the Pioneer plant for the 45,000-volt transmission line.

The considerable increase in the number and size of the cars operated on the railway system in Salt Lake City has called for an increase in energy supply, which has been met by the installation in the West Temple Street central station of two 1250-kw motor-generators. For the direct-current lighting system a large storage battery has been added to the equipment of the same station.

The company has recently extended its railway lines twelve miles south to Bingham Junction and to Sandy and Midvale. To take care of the load in that section it has built a substation one mile below Murray, which will receive energy through a tap from the Cottonwood transmission line. A similar station is also to be erected in the southeast portion of the city to provide for the rapid growth of that section. Both of these substations will feed railway, motor and arc circuits.

Acknowledgments for valuable assistance in collecting the above data and illustrations are hereby made to Messrs. O. A. Honnold, electrical engineer; L. L. Dagron, chief engineer, and C. H. Jenkins, assistant superintendent of electric lines and service.

POWER-FACTOR AND ROTARY CONDENSERS.

By L. S. Thurston.

The power-factor of an alternating-current system is the ratio of the apparent kilowatts or kilovolt-amperes flowing in the system to the actual kilowatts and equals $\frac{kw}{kva}$. The apparent kilowatts are the product of the volts and "equivalent single-phase" amperes as shown by voltmeters and ammeters, respectively, while the actual kilowatts are those shown by a wattmeter.

The kilovolt-amperes are the resultant of two currents, one of which is the power component and is in time-phase with the voltage, and the other the wattless component, which leads or lags behind the voltage by 90 electrical time-degrees. This relation may be shown diagrammatically as in Fig. 1, where *OE* represents the voltage, *OB* the power current in time-phase with *OE*, and *OC* the wattless component lagging 90 time-degrees behind the voltage. Completing the rectangle there is obtained the resultant *OA*, which represents the kilovolt-amperes. The cosine of the angle *AOB* expresses the power-factor in per cent.

As is well known, the current in any alternating-current system may or may not be in time-phase with the voltage. In commercial practice it seldom is in time-phase (generally it is lagging) nor does it pay, as a rule, to have it exactly so, but there are many systems in operation to-day where the use of induction motors, especially partially loaded ones, causes an extremely low power-factor with the resulting decrease in available permissible generator output, poor regulation, increase in line loss and increased expense in general.

Many owners and managers of plants using alternating current are beginning to realize that the raising of the power-factor of their systems is a subject worthy of their best consideration and are taking steps to do this by the installation of

synchronous motors or rotary condensers whenever feasible. Of course, it is not always commercially or financially practicable to use rotary condensers, but frequently it is, and in such case the sooner one is installed the better it will be for the system, its owners and its customers.

Alternating-current generators are designed for a certain kilovolt-ampere output and should be rated in terms of this unit and not in terms of the kilowatt output. Where the power-factor is unity, or 100 per cent, the kilowatt output and the kilovolt-ampere output will, of course, coincide, but as the per cent power-factor decreases the available output in kilowatts decreases also, although the permissible kilvolt-ampere output remains the same.

Within the range from 80 per cent to 100 per cent power-factor the kilowatt output of a generator varies, for all practical purposes, directly as the power-factor; that is, a generator rated at 100 kva will have a rating of 100 kw at 100 per cent power-factor; 90 kw at 90 per cent power-factor; 80 kw at 80 per cent power-factor, etc.; but when the power-factor is lower this ratio does not hold, because the lagging current, at low power-factors, opposes the magnetic strength of the fields, thus reducing the voltage at the generator terminals. To overcome this reduction greater excitation must be given the fields, but this means increased exciter equipment, increased heating in the generator, reduced output and efficiency and poor regulation.

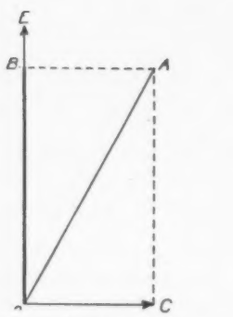


Fig. 1—Current and Voltage Relations.

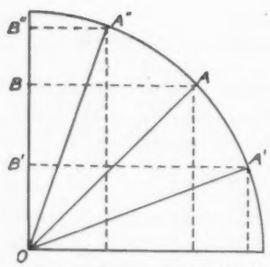


Fig. 2—Power and Wattless Components.

The effect of a low power-factor on transformers is the same as on generators, although not quite to the same extent.

The curves in Fig. 3 are drawn on the assumption that the kilowatt rating of a generator varies directly with the per cent power-factor. As there are few systems in operation having a power-factor less than 60 per cent, they may be considered correct for all practical purposes, especially as the possible errors in reading meters and the possible errors in the meters themselves will compensate for any corrections that should be made in the curves.

The horizontal lines represent available kilowatts. The vertical lines represent the wattless kilovolt-amperes flowing in the system for any given power-factor. The diagonal lines represent various power-factors in per cent and the curves represent the kilovolt-ampere rating.

Example No. 1.—Given a certain generator output in kilovolt-amperes at a certain per cent power-factor, say, 50 kva at 80 per cent power-factor lagging, how many leading kilovolt-amperes must be supplied to raise the power-factor to 100 per cent? Following the curve corresponding to 50 kva to its intersection with the 80 per cent power-factor diagonal, read horizontally outward, finding 40 kw as the available output of the generator at the given power-factor, and read vertically, finding 30 wattless, lagging kilovolt-amperes in the system. If, therefore, a rotary condenser having a rating of 30 kva is floated on the system and has its field superexcited to such an extent that it will draw from the system its full rated kilovolt-amperes, which will be leading, the wattless, lagging kilovolt-amperes in the system will be neutralized, the power-factor will be increased to 100 per cent and the available generator output will be increased from 40 kw to 50 kw.

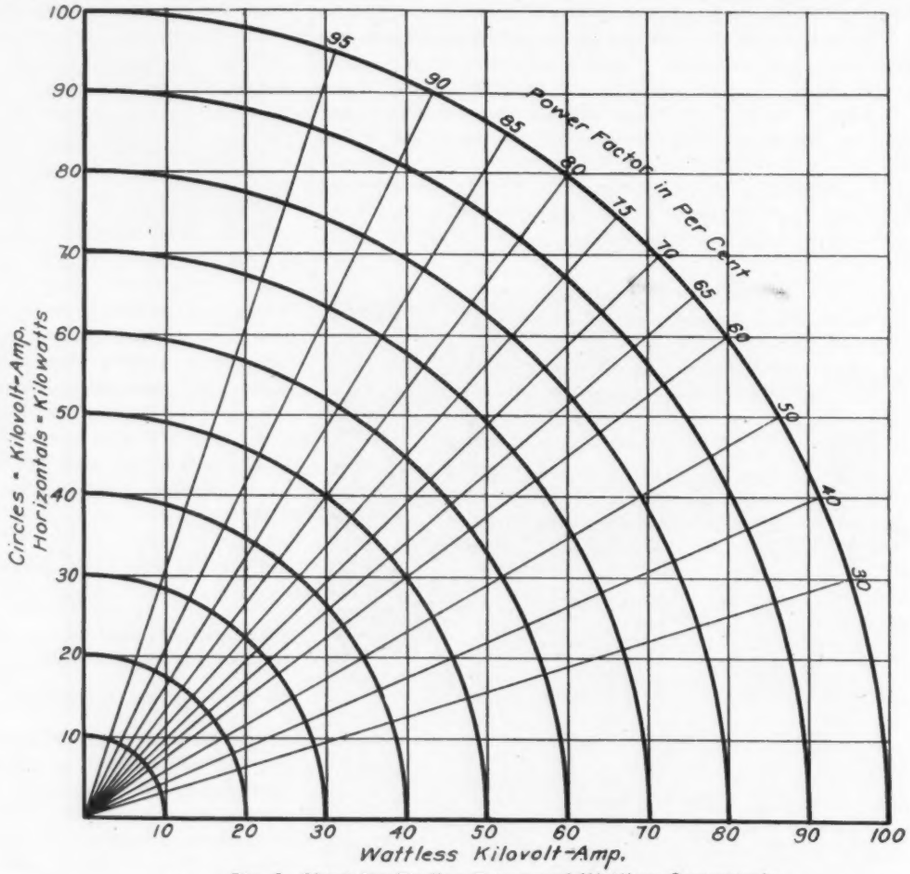


Fig. 3—Chart for Finding Power and Wattless Components.

It seldom pays, however, to install a rotary condenser of a kilovolt-ampere rating just sufficient to neutralize the wattless, lagging kilovolt-amperes, as under this condition there is no power available for doing mechanical work. A synchronous condenser operates most effectively at 70.7 per cent of its kilovolt-ampere rating, because under this condition 70.7 per cent can be utilized to raise the power-factor of the system and 70.7 per cent can be applied to do mechanical work, as will be seen from a study of Fig. 2.

In Fig. 2 *OA* represents the kilovolt-ampere rating of the synchronous motor and *AB* is the component of wattless, leading kilovolt-amperes which can be supplied to the system, and *OB* is the power component representing available mechanical work. When *AB* and *OB* are equal each equals 70.7 per cent of *OA*. This figure also shows that, since the cosine of the angles *AOB*, *A'OB'*, etc., represents the power-factor, a small addition of leading kilovolt-amperes at low power-factors makes a much greater difference in the resultant power-factor and available

power than does a larger amount at a higher power-factor. The results are tabulated herewith to show the relations even more clearly than does Fig. 4.

Example No. 2.—The curves in Fig. 2 will be found useful in solving a problem similar to the following:

Given a system transmitting 4800 kva at a power-factor of 65 per cent. Let it be desired to add a motor load equivalent to 400 kw and at the same time raise the power-factor to 80 per cent. From the intersection of the 4800-kva curve and the 65 per cent power-factor diagonal read horizontally 3120 kw and vertically 3620 kva wattless. 400 kw + 3120 kw = 3520 kw, the ultimate load.

From the intersection of the 3520 kw horizontal and the 80 per cent power-factor diagonal, on the circle, can be read 4400 kva, the ultimate apparent load, and vertically 2620, the corresponding wattless kilovolt-amperes.

Subtracting the values of wattless kilovolt-amperes found above there is obtained 3620 — 2620 = 1000 kva, which is the amount of leading kilovolt-amperes to be supplied by the synchronous motor.

To ascertain the actual kilovolt-ampere rating of the motor, refer again to the chart, where at the intersection of the 400 kw horizontal and the 1000 kva vertical the circle passing through this point corresponds to 1080 kva, which is the rated capacity of the synchronous motor desired.

When a rotary condenser is installed in a power station its effect in neutralizing the lagging currents of the system will benefit only the generators and that small part of the system between it and the generators. When, however, it is installed at the end of a transmission line, this line and all transformers and generators on it will feel the benefit of the improved power-factor. A certain size of line can transmit more power or for a certain power transmitted the wires can be smaller. For example, if a three-phase line twenty miles long is delivering 1000 kw at a power-factor of 60 per cent, a line loss of 10 per cent and a potential of 12,000 volts, each conductor must be of approximately 220,000 circ. mil area. When, however, a rotary condenser is floated on the end of the line and supplies sufficient leading kilovolt-amperes to raise the power-factor to 85 per cent, the size of each line wire could be reduced from 220,000 circ. mil to 110,000 circ. mil. This change would mean a saving of about 105,000 lb. of copper, which at 15 cents per pound would represent a total saving of $15,750.

From the chart of Fig. 2 it is seen that at 1000 kw and 60 per cent power-factor the wattless component equals 1330 kva, while at 1000 kw and 85 per cent power-factor the wattless component equals only 630 kva. Therefore, a rotary condenser having a rating of 1330 — 630 = 700 kva will be required. Such a machine complete will cost about $5,000 delivered and erected, thus showing a saving by its use of $15,750 — $5,000 = $10,750. If a larger rotary condenser were installed, although costing more money, the net saving would be still greater, as the machine could be made to perform useful work as a synchronous motor.

TABLE SHOWING FINAL POWER-FACTOR UPON ADDING SYNCHRONOUS CONDENSERS.

Kva additions in per cent of the wattless kva.	Original Per Cent Power Factor.									
	40	50	60	65	70	75	80	85	90	95
0	40.0	50.0	60.0	65.0	70.0	75.0	80.0	85.0	90.0	95.0
10	56.8	62.7	69.5	73.0	76.6	80.4	84.1	88.0	92.0	96.2
20	68.2	72.1	76.9	79.4	82.1	84.8	87.8	90.7	93.6	97.1
30	76.8	79.6	82.8	84.6	86.6	88.6	90.8	93.0	96.3	97.7
40	83.6	85.5	87.7	89.0	90.3	91.9	93.4	94.9	96.6	98.3
50	88.9	90.2	91.6	92.5	93.5	94.4	95.4	96.5	97.8	98.8
60	93.0	93.8	94.7	95.2	95.8	96.4	97.1	97.8	98.4	99.1
70	96.2	96.6	97.1	97.4	97.7	98 0	98.3	98.7	99.1	99.6
80	98.3	98.5	98.7	98.8	99.0	99.1	99.2	99.4	99.6	99.8
90	99.6	99.6	99.7	99.7	99.8	99.8	99.8	99.9	99.9	99.9
100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

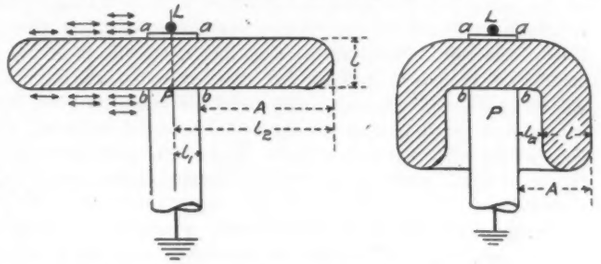
It is impossible to lay down any definite rules regarding the use of, and results obtained by, rotary condensers, but every system having a low power-factor is worth examining, for in many cases the installation of such apparatus would be found to be of advantage.

ELECTROSTATIC LIMITS IN HIGH-TENSION TRANSMISSION-LINE INSULATORS.

With the extension of the long-distance transmission industry there has been a continual crowding upward of the line voltage. For several years the transformers and other high-tension apparatus could be had for voltages much in excess of the highest practicable transmission voltage, which voltage was limited by the line insulators. Line insulators, at first designed almost wholly to fulfil mechanical requirements, increased in size and complication until their cost and weight became prohibitive and constituted a limitation of transmission voltage.

The economics of transmission called so insistently for higher voltage that transmission engineers were tempted time after time to lay out systems for voltages above standard and take it upon themselves to design insulators to fill the requirements. These attempts were seldom attended with success, and the cost was always excessive. The designs may be roughly divided into two classes—standard and freaks. The standard designs were usually successful, but their extreme weight and cost quickly became intolerable as the voltage went up. The freaks were usually based on guesswork, made in the blind hope of improving the standard type, and were unsatisfactory. Most of the freaks were impossible from the porcelain manufacturers' standpoint, and thus after being redesigned were built and installed on the line only to be scrapped or continued in operation at reduced voltage.

The invention of the suspension type insulator cleared the whole subject and set things going along the proper lines. With this type of insulator the voltage limitation of transmission lines has been transferred to the line itself, and at present it is determined by the critical voltage at which the energy loss to the atmosphere becomes excessive.



Figs. 1 and 2—Elementary Types of Insulators.

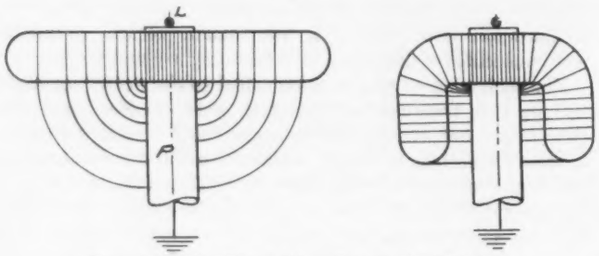
The extreme importance of the subject has caused it to be deeply studied both here and abroad, and, although most of the progress has been the result of experimental work, the radical and rational improvements have been due to proper consideration of the theory. Quantitative theoretical investigation of insulator design is not yet possible, except to those who have proper equipment for experimental determination of the factors involved. On the other hand, a qualitative analysis is easily made and serves well the purpose of indicating the effect of the different factors which enter the design.

Electrically considered, the insulator is a more or less complicated condenser, and evidently it should be so proportioned as to give a favorable distribution of dielectric flux. Large capacity means a correspondingly large charging current, and this current spreads itself over the surface of the insulator, ionizes the air and reduces its dielectric strength, thus preparing the way for the formation of corona, streamers and flash-overs in succession. The effect of rain is to increase the capacity of an insulator and thus greatly to aggravate the tendency to flash over.

In order to determine the effect of shape and relative proportions of the parts upon the effectiveness of an insulator it is convenient to consider two elementary types, as shown in Figs. 1 and 2. Fig. 1 shows a flat circular porcelain disk; L represents the line conductor and P the insulator pin. In Fig. 2 is shown the same insulator bent into the form of a cylindrical cup. The current taken by the insulator may be resolved into

two components—the charging current in leading time-quadrature with the e.m.f. and the leakage current in time-phase with the e.m.f.

The leakage current has two paths—one directly through the mass of the insulator and the other over the surface. Experiments by Mr. C. E. Skinner[1] failed to indicate any perceptible current through porcelain, and, therefore, it is safe to assume that the conductance of an insulator is that of an infinitely



Figs. 3 and 4—Elementary Types of Insulators.

thin surface film, all top surfaces of which may be wet. Referring to Fig. 1, and assuming the top to be wet and of negligible resistance, the conductance is

$$G=\frac{1}{R}=\frac{1}{k\log\frac{l_2}{l_1}},$$

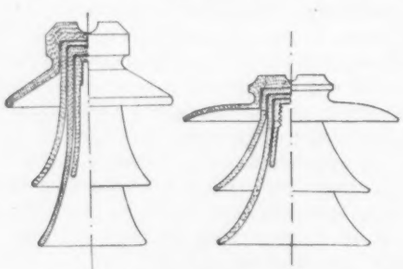
where k is a factor depending upon the character and condition of the surface. This equation indicates that increasing l_2 and decreasing l_1 decreases the conductance almost in direct proportion to the ratio. Bending the disk into the form of a cup, as shown in Fig. 2, decreases the cross-sectional area of the leakage path and therefore decreases the conductance. It is equivalent to cutting a sector from the flat disk; however, this decrease in leakage conductance is offset to a certain extent by reason of the redistribution of the dielectric flux, as will be shown later.

The charging current spreads itself radially from the conducting portions L and P over the surface of the disk, as photographs published by Mr. Karl Kuhlmann in the *Elek. Zeit.*, Jan. 20, 1910, have shown plainly. In Fig. 1 the arrows represent the direction and amount of the current.

The general formula for capacity is

$$C=k\frac{A}{l}$$

wherein k is the dielectric flux constant, A the cross-sectional area of the dielectric circuit and l the length of the dielectric circuit. The dielectric flux constant is a property of the material and is a measure of the dielectric flux which will be established by unit potential gradient. When two dielectrics are connected in series and traversed by a flux of uniform density they divide the voltage in inverse proportion to their dielectric flux constants.



Figs. 5 and 6—Practical Types of Pin Insulators.

Considering the disk, Fig. 1, the dielectric flux between L and P will be almost entirely through the porcelain disk due to the large dielectric flux constant of porcelain and the shortness of the path. Assuming rain conditions—that is, the upper portion of the surface as a conductor—the distribution of dielectric flux is about as shown in Fig. 3; the flux which goes out into space is neglected. A casual examination shows that a very pronounced maximum strain exists at the center, where the proper value of dielectric strength can easily be obtained. Next taking up the cup-shaped insulator under rain conditions and comparing it with Fig. 2, the approximate dielectric flux distribution is shown in Fig. 4. At a glance it is seen that the total flux and, therefore, the charging current are greater, the zone of maximum flux is much less pronounced, and the worst effect of all is the enormous increase in the strain produced in the air inside the cup. The dielectric flux constant of porcelain is about five times that of air. Therefore, assuming the porcelain to be of the same thickness as the air space, the relative dielectric conductances are as 5 is to 1; that is, if 60,000 volts are impressed across the two there will be 10,000 volts across the porcelain and 50,000 volts across the air. Not only is this great stress liable to break down the air-gap, but it renders the surface film more conducting and, therefore, also increases the leakage.

This theory of the insulator, which demonstrates the futility of petticoat insulators that cling about the pin, is well borne out in practice. In an article by Mr. A. S. Watts in the *Electrical World*, May 19, 1910, in which was discussed in detail the development of the present types of insulators, the two types shown in Figs. 5 and 6 were described. These insulators are shown to the same scale and appear to weigh about the same. The elongated type worked well at 45,000 volts, but for higher voltages it was impracticable to design one that would not break down under storm conditions. The expanded type, on the other hand, was successfully used at 75,000 volts. This is a striking illustration of the effect of storm conditions on the distribution of stress in an insulator.

The suspension insulator may be classed with the disk type, Fig. 1. Not only is the insulator itself a marked improvement over the pin type, but the method of installation introduces important improvements in the reliability of operation. Being beneath the metal cross-arms it is practically immune from lightning troubles, and judged from the mechanical standpoint the flexible suspension relieves the cross-arm from torsional stresses and reduces the stresses due to wind and to accidental breakage of a conductor. From the operating standpoint the suspension insulator leaves little to be desired. However, owing to difficulties encountered in the erection of lines using this type of insulator it is not practicable to use it in all cases. There is a certain voltage above which the extra cost of installation of the suspension insulator is justified by the saving in cost over the pin type. It is used in many lines of over 60,000 volts and is considered standard for e.m.fs. above 80,000 volts.

COMPARISON OF RELAYS FOR TRIPPING CIRCUIT-BREAKERS.

In a paper by Mr. A. S. Loizeaux read at the recent Frontenac meeting of the Association of Edison Illuminating Companies descriptions were given of the more important features of the solenoid type and watt-hour meter type of relay. The former relay consists of a solenoid drawing an armature toward its center against the force of gravity; the latter has practically the same construction as a watt-hour meter, but its windings are differently arranged.

The author stated that in comparison with the solenoid type the watt-hour type of relay is less liable to failure by sticking, less inclined to open too rapidly, can be set more precisely, has less impedance, consumes less power, but is not so simple and has a less range of load setting. He contended that companies that have not used watt-hour type relays should investigate them carefully.

The author expressed the opinion that relays should in general be set at higher overloads than in present general practice, in order to make their action sufficiently selective under short-

[1] *Trans.* A. I. E. E., Vol. XXVII, p. 928.

circuit conditions. The present practice in the larger Edison Companies is to set the relays on main transmission feeders to trip at a minimum of from two to four times full load. He said that an effort should be made to reduce the time element of oil circuit-breakers. Further improvements in design and operation of relays and other automatic devices should be sought.

NAVAL TESTS OF ELECTRIC COOKING.

During the spring the Navy Department made a thorough investigation of electric cooking and baking in order to determine if the electric range offered advantages over the coal range for use on board warships. We are enabled to give below some extracts from the report of the board of officers that conducted the investigation, which report, it will be seen, is very favorable toward electric cooking, both in general and with respect to its use on board of naval vessels.

The board reported that the results of the many tests with the electric range were very satisfactory, and its adoption for naval use was highly recommended. The consideration of cleanliness, elimination of coal dust and galley coal boxes, broken firebrick, soot accumulations, etc., aside from its actual working capacity, were cited as additional reasons for its supplanting the old-style coal-burning range. The range under test had been in daily use since its installation and all kinds of work that a ship's range would be called upon to perform were accomplished by the electric range under test.

The top surface of the electric range was used for all manner of cooking and heating and found to be very satisfactory. A specific test was given the top surface in the matter of frying potatoes. Fifteen minutes after turning on the switch a temperature of 340 deg. C. was recorded on the top of the range. Two quarts of oil were placed in a cooking utensil on one of the units and in fifteen minutes a temperature of 210 deg. C., sufficiently high to fry potatoes, was obtained, and the result was excellent. Two regulation baking pans were filled with potatoes (sautée), placed on the range and cooked in a manner that was wholly satisfactory, the vegetables being thoroughly browned, due to the equal distribution of heat on the heating surface. The quantity of potatoes prepared was sufficient for 100 men. Eggs were scrambled, various foods fried, and, in fact, all manner of cooking that a range would be called upon to perform was successfully done on this heating surface. With all the units on top of the range in operation for forty-five minutes, the consumption of electricity recorded was 6½ kw-hours.

In order to test if the heating coils for the top surface are fully protected against burn-outs, due to accidental spilling of liquids, a considerable quantity of water (about 3 qt.) was poured on the top of the range when heated, and it was found that the heating coils remained unharmed. The report recommends that with the top surfaces of the range should be supplied a square sheet of iron or steel, ¼ in. thick, for the purpose of baking hot cakes. This feature of the ration is much appreciated on board ship, and with the equal distribution of heat obtained on the electric range it would be practicable to obtain excellent results with a material saving of time. The ovens, with switch at "low," would make excellent warming boxes.

The broiler units were tried with all kinds of food articles, such as chops, steaks, fish, etc., always with uniformly good results. Sufficient steak (80 lb.) was broiled for 150 men, the operation taking two hours, which time could have been lessened if it had been possible to have the steak nearer the heat units. The broiler as constructed in the range tested was stated to be not quite close enough to the source of heat and a means is lacking for regulating the distance of the article being cooked from the source of heat. A simple mechanical device was recommended which would permit of the broiler being raised or lowered, as may be required. Steak broiled over the range was tender and juicy and much superior to steak fried in pans on top of a coal-burning range. Furthermore, it is practicable to cook a greater quantity of steak on the electric range than on a coal-burning range in the same length of time.

With the ovens many tests were made. A test was made of the roasting capacity of the oven, filling each of the ovens to their fullest capacity, in all 180 lb. of beef. This test was not successful, but it was later observed that the roasting pans filled the ovens completely and did not permit of the circulation of heated air; as a result the top of the beef in the upper pans was thoroughly cooked, but that in the bottom of the pans was not well cooked. On the other hand, the top of the meat in the lower pans was almost raw and had not seared in the least, while the bottom was burned. This was due, as stated above, to the lack of circulation of heated air. The report states that this can easily be remedied, either by perforating the walls of the oven with extra holes in order to permit of a free circulation of heated air, or by increasing the size of the range by about 4 in. so as to give a clear space of 2 in. on each side of the standard navy roasting pans for the proper circulation of heated air.

A further test of roasting beef was made as follows: 43½ lb. of beef were placed in two smaller pans with a 2-in. space on each side between the pans and the sides of the oven. Fifty-five minutes were required to obtain the desired temperature of 250 deg. C. The meat was thoroughly cooked in two hours and twenty-five minutes, and was very delicious. The uniform distribution of heat was partly responsible for the superior result obtained. With the change recommended to permit of the free circulation of heat it is believed that no trouble whatever will be experienced in cooking meat with the ovens filled to their capacity. During nearly the whole time that the meat was being cooked the heat was kept at an even temperature, although as the cooking was nearing completion the temperature rose slightly. This condition was remedied by the use of the switch. It was added that these ovens can be used as warming boxes for storing food that is being cooked on the top surface or on the broilers.

Tests as to relative economy of operation were made, the electricity used and the weight of the coal burned being recorded. Two roasts of beef, of equal size, shape and weight (10 lb.), were cooked in the electric and coal-burning range respectively. The thermometer was used to determine when the meat was roasted, the beef being removed from the oven when a temperature of 55 deg. C. at the center of the roast was recorded. In this test the beef roasted in the electric range was superior, being more thoroughly cooked throughout, due to the uniform distribution and steady supply of heat. Following are the data of this test:

	Electric.	Coal.
Quantity of beef	10 lbs.	10 lbs.
Time required to obtain necessary temperature	50 min.	2 hr. 25 min.
Time required for roasting	1 hr. 40 min.	2 hr. 20 min.
Electricity consumed	7 kw hours	
Coal consumed		41 lbs.
Cost	$.0525	$0.114285 (anth.) .064944 (bit.)

It will be seen that the electric range was slightly less expensive to operate.

The following table shows the relative length of time required to heat different working units of both ranges:

	Electric.	Coal.	Degrees
Top surface	15 min.	2 hr. 30 min.	340 C.
Broilers	11 min.		
Ovens	55 min.	2 hr. 30 min.	250 C.

Commissary stewards and ships' cooks who experimented with the range were of the opinion that the relative working capacity is fully two to one. A conservative opinion would rate two electric ranges equal in capacity to three coal-burning ranges. The oven capacity of the electric range is certainly twice as great, the broiler is an additional feature not a part

of coal-burning ranges, and the top surface is in point of capacity on a 2 to 3 basis.

Among its recommendations the report advises that the broilers be so arranged that the distance from the heating units may be adjusted at the will of the operator, which may be done by a simple mechanical device; also, that tight-fitting doors be attached to the front of the broiler sections in order that they may be used as warming boxes, as the present warming boxes at the top of the range are too small to be of any use on ranges in the general mess galley. In addition they serve to accumulate soot and smoke that arises from food in the process of cooking and are liable to rust, due to the steam that constantly rises from the articles being cooked on the top surface.

The final conclusions of the report are that the electric range should supersede the coal-burning range on board ship because of the following considerations: 1. Cleanliness. 2. Economy of time. 3. Economy of space. 4. Elimination of coal boxes (additional saving of space). 5. Elimination of draft troubles. 6. Elimination of soot accumulation. 7. Elimination of excessive heat in galley. 8. Economy of operation.

In view of these considerations, and of the success of the electric bake oven, both at the shore station where tested and on board ship, and considering particularly the superiority of economy of operation of the electric range, the board strongly recommended its installation on board naval vessels, both in officers' and crews' galleys.

Central Station
Management, Policies and Commercial Methods

DISPLACING GASOLINE.

As a result of the work of the illuminating engineering department of the Denver Gas & Electric Company, during the month of September twenty-one gasoline plants were displaced. From the new business the company will receive a yearly revenue of $1,600.

STEAM HEATING FROM CENTRAL STATIONS.

Mr. Reginald P. Bolton at the recent meeting of the Association of Edison Illuminating Companies presented a paper entitled "The Heating Problem in Its Relation to Central-Station Lighting and Power Service," which considers the subject from the standpoint of the metropolitan central station. His conclusion is that in the case of central stations in the great cities the intimate connection of heating with electrical service is undesirable, but it is added that in smaller towns a high degree of commercial success has been attained by direct combination of electric service and house heating. Figures are given for a plant which during the heating season of 1908-9 had an output of 4,368,100 kw-hours; the total charges of the plant, including taxation and interest, were $69,659 and the revenue derived from the sale of steam $65,972, leaving a balance of only $3,687 to be charged for the entire electrical output.

ELECTRICAL INSPECTION IN CHICAGO.

The recent investigation of the Merriam Commission on City Expenditures in Chicago shows that the Municipal Bureau of Electrical Inspection, after rapid growth, is just keeping in touch with new installations of electrical work. It is the policy of the bureau, with its limited number of inspectors, to devote itself to the inspection of all new work and of the old wiring in all buildings where many people congregate, such as theaters, churches, department stores and hotels. The Merriam Commission suggests that if the bureau has not sufficient men to cover all old installations it should be able at least to correct dangerous errors in buildings into which it is called to check up new work. Further, it is suggested that the bureau examine its records of electrical fires and determine what percentage is due to old uninspected wiring and how much to inspected work. From this data information could be obtained to show whether the reinspection of old buildings should be made part of the work of the bureau.

It is also recommended that inspectors in going about their duties be instructed to watch for faulty outside wiring and overhead construction. It is pointed out that 40 per cent of the 201 electrical accidents to persons reported in Chicago in 1909 were due to outside wiring. It may be added that 42 per cent of the accidents were due to street-railway appliances and trolley wires, and the remaining 18 per cent to interior wiring. It is recommended that an assistant chief inspector be appointed whose duty it shall be to watch the work of the men in the field and have particularly under his jurisdiction the investigation of causes of electrical fires.

It is mentioned that the bureau has recently assigned a special inspector for a resurvey of the wiring of the Union Stockyards. It is said that in this district firms are continually making electrical changes and new installations without filing an application for a permit. The commission says that the rules and regulations for governing electrical installations issued by the Department of Electricity in Chicago are even more rigid than the National Electrical Code in many instances. The bureau of inspection is to be commended for many features of its work, and it stands well in the classification of electrical inspection bureaus throughout the country.

ELECTRIC POWER FOR FARMING.

Mr. Edmond P. Edwards in a paper presented at the recent meeting of the Association of Edison Illuminating Companies stated that in 1902 thirty-five towns near Hanover, Germany, having a total population of 35,000 including outlying districts, were using about 2000 hp in motors for agricultural purposes. The Mount Whitney Power & Electric Company, in Tulare and Kern Counties, California, disposes of nearly 4000 kw to operate motors for irrigation purposes. The Rochester Railway & Light Company has installed sixteen pumping plants on farms adjacent to Rochester, and the North Shore Electric Company, of Chicago, is inaugurating a campaign along the same lines. The paper contains the table given above of horse-power required to operate machines used in farming.

Cream separator	½	to	4	hp.
Milking machine	3	to	5	"
Grindstone	½			"
Bottle washer	½			"
Water pump	1	to	10	"
Shredder	10	to	15	"
Silage grinder	10	to	20	"
Feed grinder	5	to	10	"
Threshing	10	to	20	"
Wood saw	3	to	5	"
Corn sheller	1	to	4	"
Hay press	4	to	25	"
Refrigerating	½	to	25	"

CENTRAL-STATION COMPETITION VOTED DOWN.

That it pays for a central station to keep on good terms with the public is illustrated by a recent experience of the Utah Light & Railway Company, the policy of which is to deal fairly and frankly in all matters affecting the public.

This company is furnishing electric service to the incorporated town of Sandy, about twelve miles south of Salt Lake

naving a population of approximately 1400 inhabitants. The net revenue from this service is approximately $3,000 per annum, the base rate for energy being 10 cents per kw-hour. Another company recently made application for a franchise, offering to furnish service at 9 cents per kw-hour. Representatives of the Utah Light & Railway Company appeared before the Council and advanced the usual arguments to show that the community could expect no ultimate gain by granting a franchise to a competing company. It was pointed out that the company has maintained a man at Sandy to read meters, exchange lamps, take care of line and other troubles, etc., and that in case the business were divided neither company could afford to maintain a man at this place. After careful consideration of the matter the City Council voted unanimously to reject the application for a franchise.

DETERMINATION OF MAXIMUM DEMAND.

In a paper read by Mr. R. S. Hale, of Boston, at the recent meeting of the Association of Edison Illuminating Companies the various methods used in determining the demand where this factor is one of the charges for central-station service are enumerated. The non-instrumental methods consist in determining the demand from the connected load; the connected load, but omitting lamps in certain rooms or closets; the connected load, but omitting flatirons, desk fans, etc.; on the number of rooms in a house; the area to be illuminated; the valuation of the house. These methods are used in the case of small consumers, but for large consumers the demand is determined by an instrument, such as the Wright demand indicator; the Merz device, which is a kw-hour meter automatially and periodically set back to zero, but leaving a record of the maximum kw-hours used in each period; a curve-drawing kw-hour meter; a kw-hour meter that prints the number of kw-hours consumed each half hour or other prearranged period; a record made on a tape by an attachment to a kw-hour meter which indicates whenever ten or fifty or other number of kw-hours have been used. In Boston a plan is said to be worked satisfactorily whereby the customer names his own demand. A measuring device is then installed, and if the customer exceeds the demand he named a penalty price is charged, but only for the time during which the demand was exceeded. The result is that if the customer names too low a demand the penalty charge makes his bill more than if he had named his correct requirements. If too large a demand has been specified this can be reduced, but in order to prevent the naming of a large demand for December and a small one for July it is provided that the figure cannot be decreased for a year. For each kw-hour of excess demand the charge is 20 cents.

In conclusion Mr. Hale stated that at present the tendency is to do away with instrumental measurements for small customers and either come to a straight meter rate or, if using the demand principle, to base it on some factor related to the connected load or else on one based on the number of rooms or the valuation of a house. In case of large customers the tendency is to measure the demand by some instrument making continuous record and to consider the average of half-hour periods.

"BRANCH A" IN ST. LOUIS.

The Union Electric Light & Power Company, of St. Louis, has opened a branch office at 4912 Delmar Avenue, in the West End. Here customers may pay bills, sign contracts, purchase appliances and transact any business having to do with residence lighting service. The office is in charge of a branch manager, to whom the solicitors in that territory report, thus relieving the congestion at the main office. Branch A office is located in the "White Way" district, where there are numerous moving-picture theaters, restaurants and hotels. This district is the "Hub" of the West End, and many street cars, automobiles and other vehicles are constantly passing the new office. If the undertaking proves the success that is hoped the company intends to open other branch offices in various parts of the city.

There was a "grand opening" of the West End office on Oct. 19, and the accompanying illustration is a picture of the new office taken at night. The opening celebration was continued on the following afternoon and evening. One feature of the

Branch Office of the Union Electric Light & Power Company of St. Louis, Mo.

opening which excited a great deal of attention was the free distribution of electrical household appliances. Each visitor received a card bearing a number, to which was attached a stub bearing the same number and adapted to be detached at a perforated line. The visitor signed his or her name and address on the stub and deposited it in a box, retaining the numbered card as an identification.

On the night of Oct. 20 there was a drawing and the company gave away forty domestic appliances to the successful visitors. Among these were coffee percolators, chafing dishes, 6-lb. flatirons, shaving mugs, corn poppers, waffle irons, toasters and curling irons. There was a stipulation, however, by which appliances were presented only to patrons of the company or to those signing applications for electric service. The opening was entirely successful, and about 550 persons visited the new office during the two evenings.

ANNUAL MEETING OF COMMONWEALTH EDISON BRANCH OF N. E. L. A.

A notable gathering of central-station men was held in the Gold Room of the Congress Hotel, Chicago, on the night of Nov. 1 by the Commonwealth Edison branch of the National Electric Light Association, composed of employees of the Commonwealth Edison Company. It was notable for its size, there being 461 members of the branch present out of a possible attendance of 485, and for the spirit of loyalty, enthusiasm and good-fellowship. It was the occasion of the annual meeting and dinner of the Commonwealth branch.

After the dinner had been served Mr. J. C. Manley, the retiring chairman of the branch, gave a brief address in which he reviewed the work of the local organization during the successful year just brought to a close. He concluded by announcing

the election of officers. The announcement was received with great interest, because the election followed a spirited campaign in which there were two tickets in the field, following a primary election which was held for the selection of candidates. The names of the officers elected are as follows:

Chairman, Mr. Ernest F. Smith, superintendent of substations.

Vice-chairman, Mr. Oliver J. Bushnell, superintendent of meter department.

Treasurer, Mr. William A. Fox (re-elected without opposition), treasurer of the company.

Secretary, Mr. E. J. Doyle, secretary to the president.

Executive committee: Mr. A. D. Bailey, Fisk Street station; Mr. E. H. Lakeman, construction department, and Mr. Guy W. Lunn, Fisk Street station.

The newly elected officers were introduced by Mr. Manley and they were greeted in each case by a flourish of music and stirring, amusing songs composed in their honor. Mr. Smith and the others made brief remarks. At the conclusion of this feature Mr. Manley turned the meeting over to Mr. Peter Junkersfeld, assistant to the second vice-president, who discharged the duties of toastmaster in a felicitous manner.

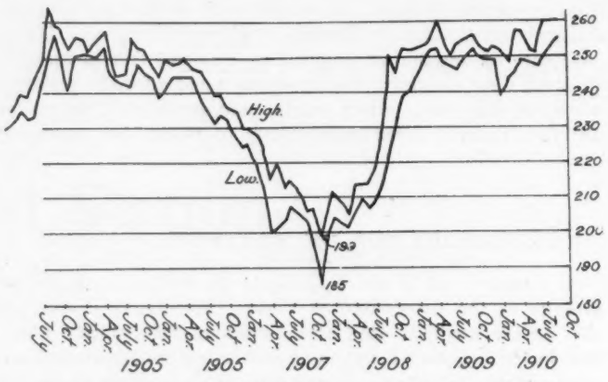
The first speaker introduced by the toastmaster was Mr. John F. Gilchrist, assistant to the president, who gave a talk on the qualities that win in central-station work. He was followed by Mr. W. W. Freeman, of Brooklyn, president of the National Electric Light Association, and also vice-president of the Edison Electric Illuminating Company of Brooklyn, who made a helpful address on the value of membership in the N. E. L. A., showing the benefits that central-station men receive by affiliating themselves with the organization. Mr. Samuel Insull, past-president of the N. E. L. A. and president of the Commonwealth Edison Company, was the next speaker. He also dwelt on the importance of the association, but the major portion of his address was devoted to a brief account of the central-station industry in Chicago. Mr. L. A. Ferguson, another past-president of the N. E. L. A. and second vice-president of the company, was called on and he took advantage of the fact to thank Mr. Freeman in graceful terms, on behalf of the local branch, for his visit to Chicago for the occasion.

During the evening, interspersed with the speeches, there were vocal selections by Messrs. Harold Wright and W. R. White and also a violin solo by Mr. C. H. Bucher, all members of the branch. Mr. R. T. Conger led the glee singing. The whole spirit of the affair was inspiring and the meeting was highly creditable, both to the national organization and to the highly developed central-station organization in Chicago which makes such a flourishing local branch possible.

INCREASING STABILITY OF CENTRAL-STATION BUSINESS AT BOSTON.

Results of operation of the Edison Electric Illuminating Company of Boston examined with reference to conditions prevailing five years ago and to-day show that the central-station business in the New England metropolis is in a most healthy condition, and that the use of electricity in the great area served by the company is advancing with rapid strides. At the end of the fiscal year ended June 30, 1905, the Boston Edison Company's records showed that the earnings for the year were $3,346,027, the total estimated population served was 722,089 and the total sales of electricity required the delivery of 41,910,281 kw-hours to customers. In 1905 the company had just begun to expand its system by the acquisition of suburban properties. It had absorbed the old Boston Electric Light Company two or three years before and was embarking upon a large policy of development which has not yet been completed. Its capital stock was quoted at about $245 maximum in July, 1905; its total capital, including stock, bonds and premium on stock, amounted to $18,281,250, and its dividends amounted to $1,070,770, or 10 per cent, for the fiscal year 1904-5.

In the fiscal year recently closed, which ended on June 30, 1910, the company's gross earnings were $4,709,456, the tributary population was figured at about 1,000,000 persons and the total energy sold was 75,684,057 kw-hours. The policy of taking over the comparatively inefficient plants and distributing systems of suburban companies in the Boston district has been carried far afield; improvements in generating plant which were barely foreshadowed in 1905 have been realized; co-ordination



Curves Showing Market Prices of Boston Edison Stock.

of distributing systems in many hundred square miles of territory combined with a vigorous commercial policy has brought the company's service close to communities formerly unacquainted with its character and possibilities. In the protracted period of financial depression which reached its climax in 1907 the company's stock touched as a low point a market price of $185 per share. The maximum price of the stock in October, 1910, was $270, which was asked a few days ago. In the five years, therefore, despite the financial depression from which more than full recovery appears to have been attained, the company's gross income has risen by $1,363,429, or nearly 41 per cent, and the market price of its stock has risen 85 points, or 46 per cent. The total capital, including stock, premium and bonds, on June 30, 1910, was $26,856,515, an increase of $8,575,265, or 47 per cent. The 1909-10 dividends were $1,555,596, representing 11 per cent for the year, and on June 30 last the stock was placed upon a 12 per cent dividend basis, the last quarterly dividend being 3 per cent. Incidentally the net earnings from operation, including all expenses of operation except taxes, interest and depreciation, were $1,989,370 in 1905, compared with $2,602,228 in 1910. Economies in administration are reflected in these figures.

A noteworthy feature of the company's expansion, its increased earnings and recovery from the conditions of the 1907 depression is the lowering of the average income per kw-hour sold from 7.983 cents in 1905 to 6.222 cents in 1910. This means that the general public received its electricity at more than 1¾ cents per kw-hour less in 1910 than in 1905, and if the 1910 consumption of energy had been paid for at the 1905 average rate the community would have been poorer by $595,000 than it is under present prices. The retail price has fallen from 18 cents to 11 cents per kw-hour in the half decade. On its physical side the company's connected motor load of 26,416 hp in 1905 compared with 57,093 hp in 1910, and its total respective connected loads in 50-watt equivalents of 1,360,909 in 1906 and 2,408,926 in the present year show the expansive tendencies of the service offered. The stability of the central-station business at Boston under present conditions is not easily surpassed in other branches of electrical service.

BREAK-DOWN ELECTRIC SERVICE IN NEW YORK CITY.

In New York City 25 per cent, or 185, of the isolated plants have a break-down connection with the mains of the Edison company. The minimum guarantee made by the break-down customers last year was $111,510 and the actual break-down revenue was $158,000.

AN ATTRACTIVE CHICAGO SUBSTATION.

As shown by the accompanying illustration, the Edgewater substation of the Commonwealth Edison Company in Chicago presents an unusually attractive appearance. This is due to the fact that it is the successor, with additions, of a former neighborhood electric light plant erected in a high-class residence section, where it was desired to make the architecture of the building conform to its surroundings. The original plant, which dates back to the year 1889, consisted of two small high-speed non-condensing engines driving Edison bipolar generators. The load was entirely lighting and the plant was operated only from dusk until midnight. In 1898 the plant was acquired by the Commonwealth Electric Company, one of the predecessors of the Commonwealth Edison Company, and was transferred into a substation. The growth of the northern section of the city has made it necessary to provide a distributing center for transmission and distribution commensurate with the demands, and the new Edgewater substation, shown at the rear in the illustration, has been very recently put into service.

The incoming lines for the new equipment are operated at 12,000 volts and 60 cycles. From the 12,000-volt buses the energy is first passed through transformers and reduced to 4000 volts, thence going through circuit switches to the basement, thence to circuit regulators on the main floor and finally to the outgoing cables on the south wall of the new building. As the 12,000-volt lines enter on the north side of the building, the construction permits straight-line buses and lends itself readily to future extensions. The ultimate rating of the station will

Exterior of Edgewater Substation.

be six transformers or 9000 kva. At present two Allis-Chalmers step-down transformers, each rated at 1500 kva, are in service.

The 12,000-volt bus structure is of concrete, and the room containing it constitutes the air chamber. The transformers are air-cooled, the blowers for them being located on the opposite side of the station from the high-tension room. The transformers are provided with a Vernier arrangement of taps on both the primary and secondary sides, by means of which, with only four taps on the coils, a 10 per cent variation of voltage in 2 per cent steps may be had.

The circuit regulators are of the induction type, each having a rating of 36 kw. The reversing switches are mounted on standards in such a way that a regulator may be moved without disturbing the reversing switch and its switchboard connections. The switchboard consists at present of six panels of black Monson slate. As no direct current is available in this substation except that supplied to a small operating battery by two mercury-arc rectifier sets, the pilot lamps are operated on an alternating-current circuit from the light and power transformers. The battery is used only for supplying energy for the operation of switches.

Correct pressure on the circuits is entirely dependent in this substation on the circuit regulators. Air for the step-down transformers is also indispensable. Extreme care is taken, therefore, to ensure continuity of service to the regulator and blower motors. Three 20-kw power transformers, star-connected on both primary and secondary sides, supply this energy ordinarily, and a fourth transformer is installed and may be quickly substituted in place of one of the others if needed.

The absence of frequency changers is an interesting characteristic of this station. Generators wound for 12,000 volts and 60 cycles are now in service at the Quarry Street generating station, and all increases in the 60-cycle districts will hereafter be taken care of by the installation of step-down transformers. The service will thus gradually be made distinct from the 25-cycle system, which has heretofore supplied energy by means of frequency changers.

The foregoing facts are taken from an article written by Mr. H. J. Richardson, of the engineering department of the Commonwealth Edison Company, appearing in *The Edison Round Table*, which is published by that company.

Wiring and Illumination

ARTIFICIAL LIGHTING OF ROOMS.

At a recent meeting of the Royal Society of South Africa the subject of the influence of uniformity and contrast on the amount of light required for the illumination of apartments was brought forward by Mr. H. Bohle. The author dealt first with the adaptation of the human eye to various daylight illuminations, and gave a fresh definition of glare. When the eye looks at an illuminant of great intrinsic brilliancy in front of a dark background it tries to do two things at once—to open wide for the dark background and to close up for the intrinsic brilliancy. The author then considered the physiological effects of radiation, explained overheating of the eyes due to excess light absorption, and considered the effects of the ultra-violet rays of modern illuminants and of solar radiation. In addition, he dealt with the destructive action of rays when applied excessively, and finally, the effect which uniformity and the avoidance of contrast in artificial lighting have on the amount of light required. He came to the conclusion that in a room with black walls an illumination of 3.5 ft.-candles to 4 ft.-candles to 40 candle-meters is required, whereas in a place with white ceilings and light walls the amount of light can be reduced to 3 ft.-candles.

SPECIAL LIGHTING IN MEXICO.

During the recent centennial celebration in Mexico City effective use was made of incandescent electric lamps in illuminating the city. A total of 220,000 electric lamps furnished the illumination. Of these 134,172 were tungsten sign lamps, 58,181 10-cp incandescents, 11,742 of 16 cp, 9112 of 20 cp, 5000 of 5 cp, 7195 of 4 cp and 3000 of 1 cp and 2 cp. Besides these 150 powerful arc lamps shed their glow over parks and street corners, while 88 250-cp tungsten lamps of the latest design helped make midnight like unto noon.

The bulk of the lighting was around the Zocalo, where the cathedral, lit up by 18,800 10-cp and 16-cp lamps, formed the most brilliant gem of all the diadem of light. Then came the National Palace, with 8900 lamps on the outside and 40,000 within, assisted by fifty-six arc lamps. The municipal palace used 10,000 incandescent lamps, while the Monte de Piedad, the government pawnshop, was ablaze with 3000 brilliant tungsten lamps. These made of the Zocalo a green emerald, ringed round with lines of bright new gold, while out from this center, through the principal parts of the city, ran rays of light, transfiguring the somber buildings into squares of glowing gilt.

Up on the Hill of the Grasshopper, where Chepultepec

Castle stands, were 15,000 lamps, 7000 in the palace itself and 8000 more scattered through the paths and around the gloriettas of the beautiful park. To these forty large tungsten lamps and twenty arc lamps gave additional brilliance, while on occasion an electric fountain spread living light above the blue waters of the lake.

TABLE OF COSTS FOR HOUSE WIRING.

In soliciting new business in residences where electric wiring is to be done it is frequently very important to the solicitor, as well as satisfactory to the householder, to be able to arrive quickly and accurately at a fair estimate of the expense which the work of wiring will entail.

A satisfactory and convenient method of finding this cost is given by the accompanying tables, which have been prepared by the Central Station Development Company, Cleveland, Ohio, for the use of solicitors in its campaigns.

According to this method the various openings for switches, receptacles, drop cords and fixtures are considered as "outlets," and on the number of these is based the cost of work in houses of different classes of construction. Adding the cost of switches, receptacles and drop cords, as given below, gives the contract price of all labor and materials necessary to complete the work.

For single floor construction the "outlet" item of the cost for various numbers of outlets is shown in the accompanying table:

Outlets.	Cost.	Outlets.	Cost.	Outlets.	Cost.
5	$15.85	24	$48.95	43	$81.76
6	17.85	25	50.60	44	83.60
7	19.85	26	52.25	45	85.50
8	21.85	27	53.90	46	87.45
9	23.85	28	55.55	47	89.37
10	25.85	29	57.20	48	91.30
11	27.50	30	58.85	49	93.22
12	29.15	31	60.50	50	95.15
13	30.80	32	62.15	51	97.07
14	32.45	33	63.80	52	99.00
15	34.10	34	65.45	53	100.82
16	35.75	35	67.10	54	102.85
17	37.40	36	68.75	55	104.77
18	39.05	37	70.40	56	106.70
19	40.70	38	72.08	57	108.62
20	42.35	39	73.97	58	110.55
21	44.00	40	75.90	59	112.47
22	45.65	41	77.82	60	114.40
23	47.30	42	79.75		

In houses of mixed flooring the prices will be the same as given in the preceding table, except as follows:

Located under double flooring, otherwise than hard wood, second or third story:	
Ceiling outlet	$1.00 extra
Switch outlet (controlling any center outlet)	1.00 extra
Located under hardwood flooring, single, double or triple, second or third story.	
Ceiling outlet	$3.00 extra
One switch outlet (controlling any center outlet)	3.00 extra
Additional switch outlets on same gang (controlling same center outlet)	1.50 extra

The cost of hardware and drop cords, to be added to the above items, depending on the number of outlets, is as follows:

Push-button switches, each	$1.00 extra
Push-button 3-way switches, per set of two switches	2.75 extra
Porcelain-base switches, each	.35 extra
Porcelain-base Edison receptacles, each	.35 extra
Base-board flush plate receptacles, each	1.15 extra
Drop-cord, key socket each	.60 extra
Drop-cord, chain socket, each	.75 extra

SUSPENSION-TYPE HIGH-VOLTAGE INSULATORS.

Two patents relating to transmission-line insulators of the suspension type were issued on Nov. 1. In a patent granted to Mr. R. M. Johnston, of Mansfield, Ohio, a description is given of a form designed so as to provide a maximum dielectric separation between points of opposite potential and to obtain interchangeability of insulator sections. Means are also provided for permitting the sections to align themselves properly with respect to each other. In the form shown in Fig. 1 the hollow body portion of the insulator is integral with the protecting skirts. The upper part is held within clamps compressed against cement held on the conical part of the body. The lower part contains an enlarged cavity within which is cemented a shoulder and sectional washer upon which rests the head of a swivel bolt provided with an eye at its lower end. The inventor calls attention to the fact that there is no conducting material within the interior of the insulating section, the construction being such as to reduce to a minimum the electrostatic stresses and the liability to puncture by lightning and abnormal voltages, while the shape and relative position of the upper and lower protecting skirts in combination with the long body of the insulating material prevents the formation of "still-air spaces."

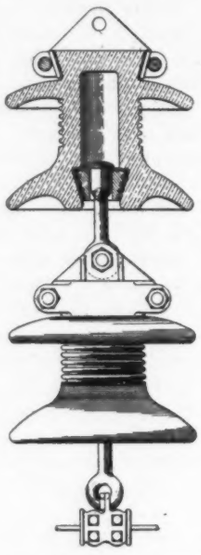


Fig. 1—Johnston Insulator.

An insulator arrangement patented by Mr. J. E. Noeggerath, of Schenectady, N. Y., is shown in Fig. 2. In this insulator special means are provided for resisting the mechanical stresses to which the insulator is subjected in service. The insulating disk is formed of porcelain, the upper knob of which is supported by a cast-iron bell to which it is anchored by means of a wire inserted through a tangential hole cut in the rim of the bell and forced around in the space formed by grooves cut within the bell and along the edge of the insulator knob. Within the knob is a central cavity enlarged at its inner end to form a circular inclined ledge against which is supported a strain bolt by means of copper balls, which when forced into contact with the porcelain will compress somewhat and distribute the pressure instead of crushing the porcelain. In order to exclude moisture the unoccupied spaces between the several parts of the unit are filled with a cement which will yield properly to tensile stresses.

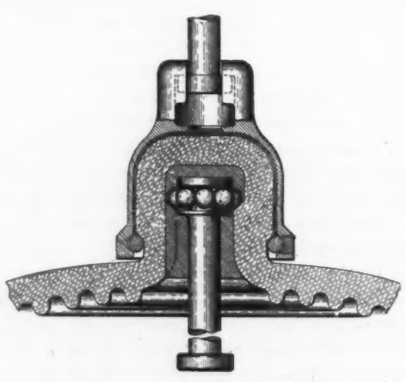


Fig. 2—Noeggerath Insulator.

FACTORY LIGHTING.

By J. S. Dow.

During the past few years engineers have come to recognize more and more the desirability of good illumination in factories. Moreover, this recognition has been shared to a great extent by most of those responsible for workshops, because it has come to be appreciated that improved illumination is really economical. It *pays* to have good lighting arrangements because this increases the output of work and diminishes accidents and mistakes.

But another aspect of the matter, which has not received quite such general attention hitherto, is the value of good illumination in factories from the purely hygienic and sanitary standpoint. Considerable advances have been made both in the recommendations of the governments of the chief European countries, and also by the inspectors of insurance companies, regarding safety from fire and obvious causes of accidents; but it is only recently that the bearing of illumination on the duties of the inspector has been appreciated. Yet it may safely be said that recommendations in this direction should be received willingly and even gratefully by the employer, seeing that he, as well as his workmen, stands to benefit. The only obstacle has hitherto been that no very definite rules have been laid down for his guidance. Factory legislation, when it refers to illumination at all, has almost invariably contented itself with specifying that the lighting should be "adequate" or "sufficient." Such regulations almost inevitably become a dead letter since there is no general understanding as to what, precisely, such terms mean.

It is, therefore, particularly interesting to notice that at the second Congrès International des Maladies Professionelles, which has just terminated in Brussels, the subject of illumination was brought prominently forward. It should be explained that this important congress is devoted to all matters connected with industrial hygiene and is attended not only by prominent medical authorities, but also by representatives of the governments of the chief European countries. Its deliberations, therefore, may naturally be expected to have an important bearing on future recommendations in relation to illumination.

Now, this year a very important precedent was set by the establishment of a special section of the program devoted exclusively to the eye and effects of illumination, and the Illuminating Engineering Society in Great Britain, realizing the importance of the occasion, sent two members of its council, Mr. L. Gaster and Mr. J. Eck, as delegates to the congress. This is probably the first occasion on which a purely medical association has invited and received co-operation from those concerned with the engineering aspects of illumination.

It was hardly to be expected that on this occasion very precise conclusions would be formulated. The papers read on the subject seem to have been mainly instrumental in awakening interest in it. But the meeting ought to give a decided impetus to the spread of interest in illuminating engineering in many influential quarters. Seeing that over 100 papers were presented, it is naturally impossible to deal with the proceedings in any detail. There were, however, quite a number of papers which dealt specially with the subject of illumination. That by Mr. L. Gaster on "The Hygienic Aspects of Illumination" contained a summary of the legislation of different countries on the subject. It also drew attention to the important reference to the matter in the most recently issued report of H. M. Inspector of Factories in Great Britain. Besides the obvious evils of bad illumination there are other points of special consequence to the sanitary inspector. For example, bad illumination is not infrequently responsible for want of cleanliness, and becomes positively dangerous on this account when poisonous materials are being dealt with, while in certain trades which are apt to lead to tuberculous diseases it is particularly inimical to health. All this was insisted upon in this report and steps are to be taken by the Home Office to collect further data on the subject. This last point was emphasized by Mr. Gaster, who laid stress on the need for more information before attempting to lay down hard and fast rules.

From the considerable amount of information presented in papers by Dr. A. Broca, M. F. Massarelli and others two points seem to have received special attention.

Almost all the speakers referred to the need for a specified minimum illumination, from the hygienic standpoint. In Holland, for example, 10 lux (about 1 ft.-candle) has already been prescribed as the general minimum and 15 lux in the case of specially exacting work for the eyes, such as embroidery, jewelry and watchmaking, draftsmanship, etc. Dr. Broca, however, expresses the view that in general an illumination of at least 30 lux to 40 lux is desirable. He explains that although it is generally assumed that a person can read comfortably with an illumination of 1 ft.-candle, this is only true when the head is brought fairly near to the book. This leads to a tendency to short sight, because people get into the habit of close reading. With daylight, on the other hand, the illumination usually suffices to enable a person to read at a considerably greater distance. Seeing that an increase of illumination above 1 ft.-candle, wisely arranged, causes no apparent discomfort to the eye, it may fairly be suggested that we ought to aim at at least 2 ft.-candles to 3 ft.-candles. Yet it might naturally be expected that at first the irreducible minimum would be fixed somewhat lower than this, though a manufacturer might often see the wisdom of adopting an illumination considerably in excess of the minimum value.

A second point which received special recognition was the importance of arranging lamps in factories in such a manner as not to interfere with the convenience of the workers or cause discomfort to their eyes. A case in which this point is specially worthy of emphasis is the lighting up of machinery which is considered sufficiently dangerous to need a guard. For if the outlines of the machinery and guard in question are indistinct, owing to insufficient illumination, there is sometimes a risk that a workman may trip over the guard; and lights that are placed so as to shine in his eyes are more likely to lead to accident than avoid it.

The importance of this connection between illumination and accidents has not hitherto been sufficiently appreciated. In many of the mills and workshops of the past, it is safe to say, many accidents to arms and fingers were due to the operator being obliged to *feel* for the lever instead of being able to see it clearly. And there should be no need to point out that when every step has to be taken cautiously and in doubt, owing to the indistinct surroundings, much valuable time is lost.

There were also a number of other papers which dealt with eyesight of operators and with such nervous defects as "nystagmus," an affection of the eyes from which miners are apt to suffer; this, it was suggested by several delegates, is at least partially due to the peculiar conditions of illumination under which such men work. Again, reference was made to the severe tax on eyesight imposed by certain operations in mills, such as carding, knitting, etc. Mr. A. Glen Park mentioned that in considering a "certificate of fitness" it was always regarded as very important that the applicant should have excellent sight. Now, one may well raise the question how far the exacting nature of these processes is due to defective lighting and whether, if proper precautions were taken in this respect, the conditions as regards eyesight might not be relaxed.

At the recent congress the intention of speakers seems to have been mainly to arouse an interest in the subject of illumination rather than to attempt premature definite rulings. This is the first essential step toward progress and it may be hoped that information will be accumulated by the permanent commission, which exists under the presidency of Dr. M. Christoforis. M. Massarelli, to whose paper reference has already been made, was one of those who pointed out the need for much more definite information than is possessed at present. "How long," he inquired, "will it be before hygienic experts can formulate definite rules for the guidance of practical men?" In fact, the recognition of the need for such recommendations is widespread. The only difficulty in the past has been that the experts concerned have not been brought into contact. This deficiency, we may hope, will be effectually removed by the work of the illuminating engineering societies.

DISPLAY STREET LIGHTING IN TOLEDO, OHIO.

In a paper presented by Mr. W. E. Richards before the annual meeting of the Association of Edison Illuminating Companies held at Frontenac, Thousand Islands, Sept. 6, 7 and 8, and just released for publication, the plan of display street lighting as accepted in Toledo is given. This system of lighting, as well as the general street illumination, utilizes 4-amp magnetite arc lamps, connected fifty in series, there being a total of approximately 2500 lamps, covering an area of 49 sq. miles. Inasmuch as practically all the light emitted from the luminous arc falls below 10 deg. from the horizontal, display signs which are usually above this axis are not affected by the glare produced.

The City of Toledo has contracted with the local lighting company for its illumination at $45 a lamp per year. While this is admittedly low, a higher rate, the author contends, would be inimical to the plan adopted. Obviously, at this contract price and owing to the necessarily excessive construction costs, the business is not desirable from the serving company's viewpoint. The cost of its display lighting is divided between the city and the property benefited, the city paying 15 per cent and abutting property being charged on the tax duplicate with 85 per cent of the total bill. The net cost to the property owners averages 90 cents per foot front per year, an ordinary business front of 20 ft. costing a merchant $18 per annum. By means of extra flexible duplex lamp loops the arc-lighting system has been relieved of many open circuits. In fact, during the five years the contract has run open circuits due to lamp-loop troubles have been extremely rare. The records of the company of outages and dark hours, from all causes, vary from 6/100 per cent to 1 per cent, the greater proportion being due to mechanism trouble in the lamp itself and to trouble in the power station.

The map given in Fig. 2 shows that on some streets lamps

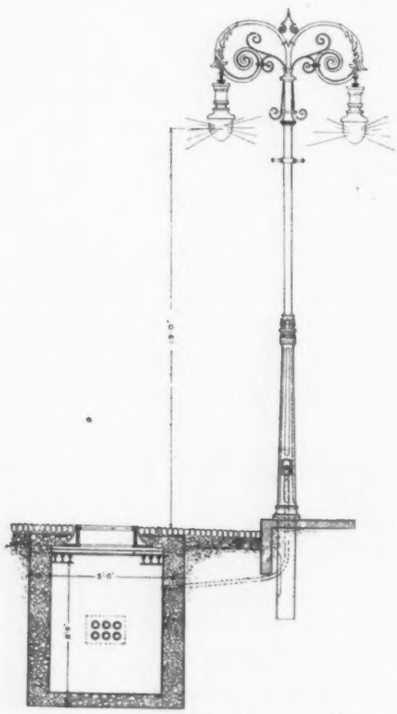


Fig. 1—Arc Lamp-Post Details, Toledo, Ohio.

are located 80 ft. apart with 80 ft. between street curbs. On certain streets this is extended to 100 ft. centers. In all cases two arc lamps in series or multiple are installed, 80 per cent of this class of lighting being on the series system. In certain locations where the current or voltage is not excessive a remote-control switch is employed to close and open the arc circuits on regular schedule. The series underground circuit lines for the display lighting consist of individual cables for convenience of testing and identification. The lamp loops are taken off the outgoing cable and after passing through the last lamp the circuit is returned through one cable by the shortest path to the station. These cables are made up of No. 10 B. & S. wire, paper insulated. Where a lamp loop is cut in the same size cable is used for this loop, but duplex wire with rubber insulation is

Fig. 2—Map of Business Section, Toledo, Ohio.

employed in feeding the lamp. After entering the pole base this cable is spread at the ends, where soldering joints are made to No. 12 wire. The lamp-post wiring is coated with soapstone

Fig. 3—Ornamental Lamp-Posts in Toledo, Ohio.

and drawn into ordinary circular loom. It is then inserted into the lamp-posts, which are designed to be as nearly waterproof as possible. It has been thought that the rubber-covered wire will deteriorate rapidly in iron poles, due to the action of sulphurous gases, but after five years' experience the company finds no trouble whatever from this cause. Rubber-insulated wire is used because of short bends being necessary to conform with the inlet connections. Moreover, a pot-head is unnecessary,

and where the lamp loop is joined to the main cable the ordinary wiped joint suffices. The usual conduit system is in use, preference being given to fiber conduit and concrete manholes. The company has found that 1-in. galvanized-iron pipe is preferable for running laterals from the manholes to lamp-posts. In many places the pipe is made up and passed through holes bored through street crossings. In parks, where the conduit is not

Series luminous magnetite arc lamps, cost each	$23.65
Ornamental iron lamp-posts	45.00
Complete cost of construction:	
Series system per lamp installed	106.00
Multiple system per lamp installed	85.00
Total maintenance cost per year	6.30
Cost of mercury arc tubes per lamp per year	3.81
Average life of rectifier tubes	890 hours
Average life of lower electrode	170 hours
Average life of upper electrode	2 years

likely to be disturbed, ½-in. fiber conduit, without concrete, is found to be desirable on account of low cost. Regarding the maintenance of the display-lighting system, the author states that the lamps are permanently fixed about 19 ft. from the street. With the type of lamp employed an average of 170 hours is obtained on a single trim. A trimmer provided with a light ladder of special design is capable of looking after some 250 lamps, since only the lower electrode is changed, the upper electrode having a life of practically two years. The accompanying table contains in a condensed form the items of interest in this class of work.

NEW TELEPHONE PATENTS.

PRIVATE BRANCH INTERCOMMUNICATING SYSTEM.

The combined intercommunicating system and private-branch exchange has become quite an important factor in furnishing telephone service. Such a system provides not only the features of the old intercommunicating system; that is, the means by which any station may call and connect with any other without the assistance of a central operator, but, in addition, it provides for connection with the public exchange from any of its stations. It has been customary to receive all exchange calls at a single designated station and from there to distribute them as desired. Such a special switching system involves the carrying out of numerous special conditions, and considerable effort is being expended to devise a system and apparatus which will give the most comprehensive and satisfactory service.

In the system recently patented by Mr. N. H. Holland, of Chicago, and assigned to the Western Electric Company, means are provided for answering the exchange trunks on any station, from which the trunk may be held pending a supplementary and secret communication with any other station. According to this system each station has a key for answering, one key each for selecting each other station, one key for each trunk and two ringing keys. One of the latter is for ordinary calls and one for calls supplementary to trunk connections. When a trunk call arrives, as indicated by the trunk signal or bell, the trunk key is depressed at the answering station, which establishes connection with the trunk. If it is necessary to communicate with a second station, the selective key of that station is depressed. This key becomes locked, but the trunk key is not coincidently released. The supplementary ringing key is now depressed. This calls the second station, releases the trunk key and simultaneously closes the trunk-holding circuit. This last circuit is controlled by two relays, one a self-locking relay and the second a relay in series with the trunk. The circuit has a normal gap or break at the locking contacts and it is necessary to bridge this momentarily to close the lock and holding circuit. If the second station desires to talk upon the trunk, the closing of its trunk key will connect it and automatically cut the lock and holding circuit. Similarly, if the first station wishes to cut in again on the trunk, its trunk key may be depressed, which will at the same time release its switching key to the second station which was just communicated with.

Another patent granted to the same inventor and similarly assigned describes a Dictograph set comprising switching keys, visual signals, a buzzer and transmitter and loud-speaking receiver all assembled in a frame and casing in a convenient manner. The transmitter and receiver are carried by an auxiliary frame swinging upon the main frame in such a way as to permit of convenient positioning for use.

Mr. O. M. Leich, of Genoa, Ill., has patented a wall-type subscriber's set for rural use in which special provision is made for the mounting or changing of condenser. The condenser is to be used to prevent interference with the transmission of ringing signals due to receivers being off the hooks. The condenser, induction coil and transmitter are all mounted upon the hinged cover of the set and the wiring is led to and from the condenser holder so as to be readily accessible. This patent is assigned to the Cracraft-Leich Electric Company.

SUBMARINE SIGNAL RECEIVER.

One of the difficulties of submarine signal receivers is that of variation of external pressure according to the depth at which used. One of the advantages lies in the ability to use any desired pitch, and therefore resonating chambers are available for reinforcing the received sounds. Messrs. F. M. Durkee, of Newton, Mass., and J. B. Millet, of Boston, have had both these points in view in the design of a receiver they have patented jointly and assigned to the Submarine Signal Company. A sectional view is shown in Fig. 1. The transmitter is designed for sounds of high pitch. The diaphragm is under tension, as its edges are soldered into position while it is expanded by heating. The effects of pressure and the consequent deflection of the diaphragm are overcome by making the microphone of the inertia type. Again, the cavity of the transmitter is made to resonate and thus reinforce the sounds received.

PARTY-LINE APPARATUS.

With party-line telephones connected in considerable numbers to a single line, for rural service, there is at times more or less trouble due to persistent listening-in upon the lines of non-wanted stations. This has led to the invention of numerous devices for locking out all save desired stations. Unfortunately, most such systems are unreliable, chiefly through the distribution of rather complicated and delicate apparatus throughout the line, or, in other words, at each station. In the effort to overcome this objection Mr. W. M. Bruce, Jr., of Springfield, Ohio, has produced a lock-out system depending upon a simple limit relay, one of which is to be at each station.

The relays are so proportioned as to resistance and efficiency that any one of them will operate if connected across the line through the closing of the hook switch. This relay in operating closes a shunt contact which short-circuits a large portion of its winding, leaving, however, enough to lock it. The relay of reduced resistance so alters the potential distribution on the line that the relays at all other stations will fail. Thus all are locked out, as the telephone circuit at the stations is closed only through the closing of the relay contacts at that station. Mr. Bruce's patent is assigned to the American Automatic Telephone Company.

Another system for party lines with the same ultimate end in view provides a code signal for each station, which signal is repeated upon the line each time the hook lever rises. Thus, if any conversation is existent an interfering station signals those using the line of its presence, at the same time identifying itself. This system is patented by Mr. J. W. Nilsson, of North Dakota.

SWITCHBOARD-CIRCUIT SYSTEM.

A switchboard-circuit system has been patented by Mr. A. D. T. Libby, of Elyria, Ohio, which is a sort of compromise between the two-wire and three-wire systems. This system, the patent for which is assigned to the Dean Electric Company, employs the usual line circuit and three-wire jacks of the three-wire system. A cut-off relay in the sleeve circuit responds to the plug sleeve and cuts all line signal apparatus from the line.

The cord circuit is the well-known four-relay cord circuit, one relay for each cord serving to cut-on the supervising lamp and a second serving the lamp circuit. In this system, however,

the circuit-closing relay is connected to the sleeve or third wire, the cut-off relay being left connected to the tip cord strand. A retardation coil is used to lead the talking battery to the ring strand of the cord. A feature lies in the connection of the ringing circuit through an extra contact of the cut-off supervising relay. This is done in such a manner that the response of the called party stops further application of ringing current.

TELEPHONE RECEIVER.

Mr. G. W. Pickard, of Amesbury, Mass., has patented a receiver of the head or watchcase pattern. This receiver is adjustable, as a thumbscrew projecting through the rear of the case provides a means of adjusting the air-gap. The thumbscrew drives the whole magnetic system in guides within the case. A further feature lies in the arrangement of the terminals as an open-space cut-out, a middle block attached to the cores of the coils serving to prevent the existence of a heavy potential difference between core and windings.

AUTOMATIC SELECTOR.

In some automatic exchange systems the multiple contact joints are arranged in a circular series corresponding to numbers 1 to 100. With such systems the selector arm has an extremely short travel for low numbers and a long travel for high numbers. As with the usual electromagnetic drive each angular unit requires the same time for operation, such a selector is slow for high numbers. This difficulty may be largely overcome and at the same time the division and sending of numbers by digits may be introduced by the method of driving the contact arm devised by Messrs. H. B. Holmes, of Park Ridge, and E. B. Craft, of Wilmette, Ill. In their selector, described in a recent patent assigned by them to the Western Electric Company, there is provided a constantly rotating main shaft driven by mechanical power, such as a belt. The contact arm is mounted concentrically with this shaft, but it is loose from it. The shaft may be connected and freed at will through the use of a magnetic clutch with a toothed wheel, and this wheel carries a second toothed wheel, the latter secured to the contact arm. The tens digit is sent by a contact maker, the time of closure of which corresponds to the required angular rotation of the power shaft for the desired set of ten contacts. During closure the clutch is fast, and the power shaft drives both the wheels and the arm. For the units figure the upper wheel alone is driven by a stepping magnet, the teeth upon the step wheel corresponding to the angular distance of adjacent contacts. For the number 75, therefore, the travel of the sender arm closes the clutch until the contact arm is carried around to the seventh group of ten. The clutch releases and the retaining pawl holds the wheel. Five impulses to the stepping magnet advance the upper wheel five units. The restoring of the selector is accomplished by withdrawing the retaining pawls, whereupon springs drive the two wheels back home.

PRIVATE BRANCH EXCHANGE.

A patent relating to the private branch intercommunicating exchange has been obtained by Messrs. J. N. Wallace and E. B. Craft, which patent has also been assigned to the Western Electric Company. The particular feature lies in the means of holding a trunk or exchange line while the answering station is transferring the call to a desired station. The holding circuit, a shunt across the trunk line, is controlled by relays. The governing relay is polarized and becomes active only when a calling plug at the central office is occupying the jack of the trunk line. In other words, the battery polarity existing upon the trunk is reversed by calling upon the trunk from the central office. As this is the only condition under which a transfer is necessary, it follows that the trunk can be held only under proper conditions. With the trunk properly poled and the trunk key at any station depressed, if a local key be depressed the polarized relay will respond and in turn cause the operation of a locking holding relay. When the trunk key at any other station is depressed an unlocking relay restores all to normal.

Letter to the Editor.

Electrical Charge on Dead Wire.

To the Editor of Electrical World:

Sir:—In a recent issue mention was made of an electrical charge found on a one-mile section of disused wire which was well insulated from the ground, and it was suggested that the wire might have received its charge from the exhaust of a locomotive which passed on a track parallel to the wire.

A similar incident was recently brought to the notice of the writer. Two linemen who were stringing a section of copper wire for a transmission line received a severe shock by coming in contact with the wire after it had been strung on the insulators for a couple of hours. The incident occurred on a hot, dry day in June, with no wind. Three trains passed parallel to the entire section in the interval between the stringing of the wire and the discovery of the charge.

It seems improbable that the phenomenon could be traced to the exhaust of the locomotives, as there was no wind to blow the vapor across the wire. Readers would confer a favor by suggesting a possible cause of the charge.

University of Illinois, Urbana, Ill. R. St. Clair Seese.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Three-Phase Commutator Shunt Motor.—L. Dreyfus and F. Hillebrand.—In former papers on the theory of the three-phase commutator shunt motor the opinion has often been expressed that the circle diagram of the ordinary induction motor is valid directly for the three-phase commutator shunt motor if its brushes are short-circuited so that no external voltage is impressed on the armature. The authors first show that this is not correct, but that there is an essential difference between the induction motor and the commutator motor because the circle diagram of the commutator motor is affected strongly by the rotor stray flux. Formulas and results of experimental tests of a motor are given. The short-circuit currents below the brushes are also a distinguishing element, but are of much less importance than the rotor stray flux. The paper is to be continued.—*Elek. u. Masch.* (Vienna), Oct. 16.

Stray Field of Transformers.—W. Rogowsky.—The conclusion of his paper on a new experimental method for studying the stray field of transformers. The first part of the paper was abstracted in the Digest last week. In the present instalment the author discusses especially the effect of the iron on the stray field and gives results of measurements made with a transformer with a ratio of transformation of 1 to 1.—*Elek. Zeit.*, Oct. 20.

Magnetizing Current.—M. Kloss.—A mathematical paper giving a new quick method for calculating the magnetizing current of induction motors and for calculating the maximum induction in the teeth.—*Elek. u. Masch.* (Vienna), Oct. 9.

Generators, Motors and Transformers.

Iron-Silicon and Iron-Silicon-Nickel Alloys.—S. Guggenheim.—Former work of W. Barret, W. Brown and R. Hadfield has shown that with increase of silicon in an iron-silicon alloy the hysteresis losses and the eddy-current losses decrease, but that the permeability also decreases. The author endeavored to find an iron-silicon-nickel alloy which would combine small losses with high permeability. However, it is known that a small addition of nickel decreases the permeability. Moreover, the addition of silicon alone permits an increase of

the permeability to $B = 12{,}000$, and therefore he experimented mostly with simple silicon-iron alloys. Fifteen rings were tested, containing silicon up to 4.8 per cent and nickel up to 2.8 per cent. Steel containing over 5 per cent of silicon was too hard and brittle. The results are given in Figs. 1 to 3. Fig. 1 gives the specific resistance as a function of the per-

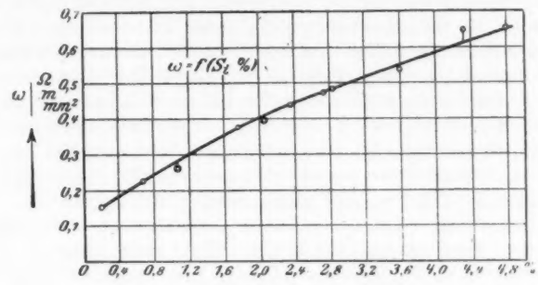


Fig. 1—Percentage of Silicon.

centage of silicon. Fig. 2 gives permeability and hysteresis losses for B maximum $= 8000$ as functions of the percentage of silicon. Fig. 3 gives the hysteresis loss in ergs per cycle per cubic centimeter as a function of the percentage of silicon. The best alloy found by the author contained 94.8 per cent iron, 4.8 per cent silicon, 0.3 per cent carbon and 0.1 per cent manganese. The specific weight of this steel is 7.43, specific

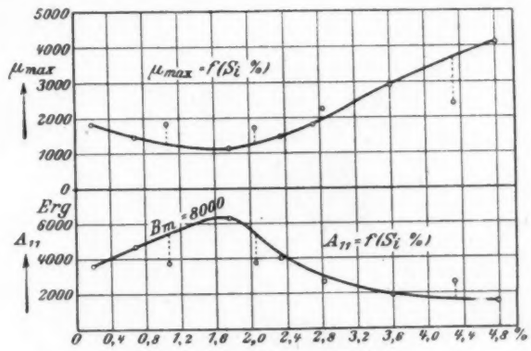


Fig. 2—Percentage of Silicon.

resistance 0.65, μ maximum $= 4100$ at $H = 1.5$; hysteresis losses 1700 ergs per cycle per cubic centimeter at $B = 10{,}000$; eddy-current loses 0.16 watt per kilogram at $B = 10{,}000$ for a frequency of 50 periods and a thickness of the sheets of 0.5 mm. Beginning with $B = 14{,}000$ the B-H curve bends and becomes very flat and beginning with $B = 15{,}000$ the curve is lower

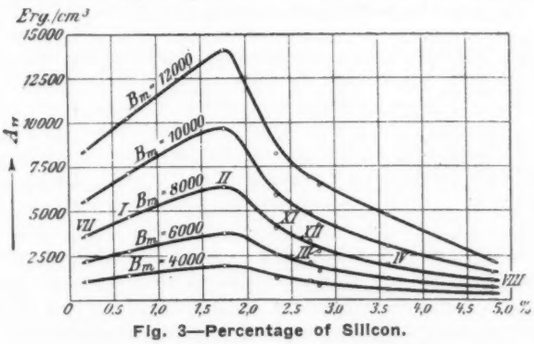


Fig. 3—Percentage of Silicon.

than that of all other alloys. On the other hand, the curve for an alloy containing 2 per cent silicon and 2 per cent nickel rises above all other curves beginning with $B = 14{,}000$, but this alloy is only half as good with respect to the losses. The author did not experiment with higher inductions like $B = 15{,}000$, such as are now often used in practice.—*Elek. Zeit.*, Oct. 20.

Lamps and Lighting.

Cost of Lighting with Incandescent Lamps.—Besides the specific power consumption in watts per candle-power other factors must be considered in determining the economy of different types of incandescent lamps. These are the price, the useful life and the number of candles. The latter is of importance in calculating the amortization, since the prices of lamps of different candle-powers are approximately equal within certain limits, so that the amortization is the higher the lower the number of candles. The cost of one cp-hour in cent is $K = wf + a/(sn)$, where w is the watts per candle-power, f the cost of a watt-hour in cents, a the cost of the lamp in cents, S the useful life of the lamp in hours and n the candle-power of the lamp. $a/(sn)$ is the amortization. The author gives the numerical data for various carbon, tantalum, tungsten and zirconium lamps, and gives a diagram from which the cost of the cp-hour for different lamps can be directly determined. Some numerical examples are added to show under what conditions certain lamps are more economical than others, especially to show how the situation changes with a change in the cost of the kw-hour and with a change in the candle-power of the lamps selected.—*Elek. Anz.*, Oct. 20.

Electricity for Shop Lighting.—Five illustrated articles on electric store lighting and store-window lighting. They commence with some notes on the general arrangement of store-lighting installations, the number and position of lamps required, and illustrations of some suitable shades and reflectors are given. Store-window lighting is next dealt with in a separate article, and the relative merits of various methods of arranging lamps are discussed, several forms of reflectors for effective concealed lighting are illustrated, and this form of illumination is recommended as preferable in a great number of cases to lighting by lamps hung on visible pendants, etc. The use of arc lamps is also considered, and a few notes on decorative lighting are given. A number of forms of lantern for exterior shop lighting are illustrated, and the general question of lighting store fronts from the outside, both by incandescent lamps and by arc lamps, is dealt with. A few figures as to the cost of arc lighting are given. A more technical article follows, giving detailed descriptions of the various electric signs. These range from the simple box sign for window advertising, consisting of a sheet-metal box with painted glass fronts and a thermal flasher controlling a single lamp, to the enormous writing and color-changing signs erected on the outside of buildings. The latter are controlled by motor-driven switches, some types of which are described and illustrated. Various means are adopted to give clear and brilliant effects without producing an unpleasant glare. The exterior signs must also be waterproof and durable. Finally, tables are given showing the cost of lighting by metallic-filament lamps. Figures are given both for osram and tantalum lamps. The latter are not quite so economical in energy consumption as the tungsten lamps, but the cost of the lamps themselves is less, and the lamp will also stand rougher usage, since the filament, which is of wire-drawn tantalum, is tougher.—Lond. *Elec. Eng'ing*, Oct. 20.

Manufacture of Metallic-Filament Lamps.—B. DUSCHNITZ.—An illustrated description of various new appliances used in the manufacture of metallic-filament lamps, especially presses, furnaces, apparatus for the formation of the metallic filaments, etc.—*Elek. Anz.*, Oct. 9 and 13.

Generation, Transmission and Distribution.

Oil Testing.—W. YORKE.—An article on inexactitudes of oil testing in power plants. Notes are given on tests of density, viscosity, flash point, fire test, gumminess, acidity and evaporation, but it is pointed out that the most important property of the oil is its emulsifying tendency. It is emphasized that a mineral oil may emulsify readily with water from one district, and yet may show no inclination to mix with water from another area. It is important, therefore, when investigating this tendency that the treating water be taken from the actual situation. This implies the use of the condensed steam from the particular engine or plant when trying cylinder oils. The good results achieved with an oil in one plant are therefore not necessarily applicable to another and similar plant, unless the characteristics of the water in each are related. When the comparison of various cylinder oils is under discussion the

emulsifying tendency should be regarded as the most significant, for the conditions under which these oils work are such as to completely satisfy any miscible tendency. The chief disadvantages of an emulsified cylinder oil are: (a) The lubricating power is much reduced and a greater quantity of oil is required. (b) The emulsion is more easily washed from the cylinder walls, which also increases the consumption. (c) The pollution of the condensed steam, after which, owing to the very intimate connection between the oil and the water, its use for boiler-feed purposes is undesirable unless a costly purifying plant is employed to destroy the emulsion.—Lond. *Elec. Review,* Oct. 21.

Traction.

Tramway Line with Surface-Contact System.—An abstract of last year's account of the tramway system of Wolverhampton, where the Lorain surface-contact system is in use. The working expenses show a small increase, due mainly to extra repairs being carried out in connection with the permanent way and the Lorain equipment. The system, however, continues to compare not unfavorably with undertakings where the overhead trolley has been adopted. The traffic during the past year shows an increase compared with that of 1908-9, the total number of passengers carried being 9,670,657, as against 9,050,459, the number of passengers per car-mile averaging 9.38 and 9.4, respectively. The number of kw-hours used per car-mile, namely, 1.408, is smaller than last year's figure of 1.56. The consumption for 1907-8 was 1.60 kw-hours. The total working expenses per car-mile, including capital charges, are 18.56 cents (18.74 in the year before). The total working expenses without capital charges are 12.84 cents (against 12.74 cents). The item of repairs and maintenance is 2.90 cents (against 2.36 cents).—Lond. *Electrician,* Oct. 21.

Gasoline-Electric Car.—An illustrated description of gasoline-electric cars used on the tramway system between Point Shirley and Winthrop, in Massachusetts, on account of the great distance of the line from a suitable electric power station. The prime mover is a gasoline engine connected to a direct-current generator. The speed of the car is controlled by varying the impressed voltage. This is done through altering the engine speed by keeping the spark advanced and running on the throttle. The car lighting is by the Apple system, in which a low-voltage, direct-current generator is driven by the flywheel of the engine. The generator delivers energy to a storage battery which feeds 20-watt tungsten lamps. The storage battery also supplements the low-tension ignition system.—*Elec. Ry. Journal,* Oct. 22.

Single-Phase Traction.—Bandow.—The conclusion of his paper read before the Berlin Electrical Society on the Westinghouse-Bergmann single-phase traction system. In the present instalment the author deals especially with the construction of the current collectors, motors, etc.—*Elek. Zeit.,* Oct. 20.

Installations, Systems and Appliances.

Electricity in Textile Mills.—F. Nasmith.—A paper read at the Manchester Engineering Exhibition. The author points out the large field for the adoption of electrical devices in connection with textile machinery. As showing what can be done he describes the application of the Brown-Boveri motor to ring spinning, the quick production of new designs in weaving, and the Chapman electric neutralizer for removing the effect of static electric charges in spinning. A very present evil in spinning mills is static electricity, generated by the friction of the fibers during treatment. Considerable trouble is given to the operators through the presence of this static electricity; woolen roving, for instance, will stick to the rub rollers on the finisher cards, causing breakage and irregularity in the subsequent yarn; the yarn is rough, loose short fibers standing out from the closely adhering main body of fibers; the web passing from the doffer breaks down when starting up, and, due to the before-mentioned sticking, the amount of waste is comparatively high. The remedy devised by Chapman is as follows: A special transformer is provided, which is bolted up to the wall or ceiling in any convenient place, and serves to deliver the electric current in the proper form to the various machines where the static electricity is to be neutralized. A single line of heavy insulated wire leads from the transformer to the various points of treatment. This line may be run along the ceiling over the machines or under the floor on which the machines sit. On each machine is placed one or more inductors connected to the line wire. The inductor is a steel tube 1½ in. outside diameter, of suitable length to reach across the machine, slotted on one side from end to end, and having a series of porcelain blocks in the slot. The blocks contain the active points from which the influence is radiated to the charged material, and a heavily insulated cable runs through the inside of the tube and distributes the alternating charge to the several active points by induction. The tube itself is earthed, but the line wire is connected directly with the cable inside the tube. The connection is made through a convenient form of removable socket at the end of each inductor. The inductor is placed at some point in the machine where the charged material may pass by it at a distance of from 1 in. to 3 in. and the material becomes instantly neutralized thereby, even when running at a speed of 1000 ft. per minute.—Lond. *Electrician,* Oct. 21.

Alarm-Signaling Devices for Circuit-Breakers.—S. Lees.—An illustrated description of various signaling devices for use in connection with automatic circuit-breakers. They may have the form of a bell alarm or a lamp signal, or a combination of

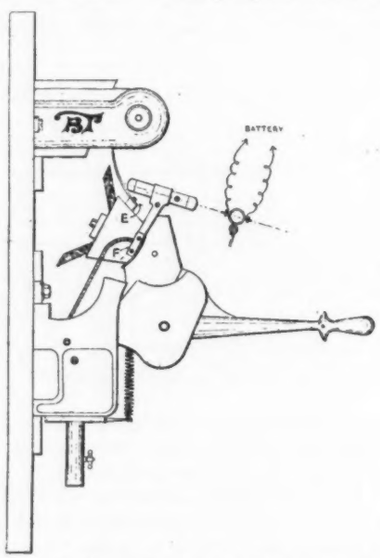


Fig. 4—Alarm Device for Circuit-Breaker.

both. Sometimes a telephone relay working in conjunction with a circuit of lamps is used. One method described is shown in Fig. 4, mercury being used in it as a conductor. Normally when the circuit-breaker is closed the position is as shown at *B,* Fig. 5. On the circuit-breaker opening the mercury falls by gravity, as indicated at *C,* and submerges the metal contact studs *I,* completing the bell circuit. The sketches show the details of its construction. This type of contact device has the advantages not only of simplicity and easy fitting, but also of being applicable to most types of circuit-breakers. The clipper holder *D* (Fig. 5) is simply secured under the screw heads of the "blow-out" subsidiary contact fingers *E,* or coil lead *F* (Fig. 4). For this form of device the author uses for the shell or casting and plugs a good quality of red vulcanized fiber (spent cartridge fuse cases are suitable). An alternative design, with screw-threaded plug, is shown at Fig. 6. A method for fixing the alarm device on the back of the board is also described.—Lond. *Elec. Review,* Oct. 21.

Alternating-Current Motor Starter.—A note on a recent British patent (21,357, Oct. 13, 1910) of A. C. Heap. In order to obtain a gradual increase of the applied pressure when starting alternating-current motors the starter consists of a 1 to 1

ratio transformer with the primary and secondary windings arranged so that their inductive relations can be continuously changed from zero to a maximum. Automatic gear is provided to prevent too sudden an increase in the applied pressure and to cut out the transformer immediately when the full voltage has been applied.—Lond. *Elec. Eng'ing*, Oct. 20.

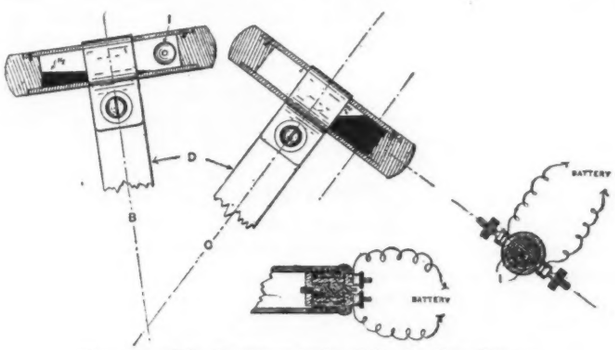
Motor Control.—A note on a recent British patent (1146, Oct. 13, 1910) of the British Thomson-Houston Company (General Electric Company of this country). In the system employing "notching relays" to regulate the successive closing of the contactors the relay series coils are arranged to serve as overload relays to open some or all of the contactors on an overload, thus protecting the motor by reducing the voltage applied. For this purpose contacts on the "notching relays" are connected with respect to the corresponding contactors so that the circuits of the latter are opened when the relays operate on an overload.—Lond. *Elec. Eng'ing*, Oct. 20.

Wires, Wiring and Conduits.

Destruction of Wiring Insulation.—K. SIMONS.—An illustrated article in which the author describes a case of destruction of a wiring installation and especially the destruction of the insulation due to moisture, growth of fungi and formation of rust.—*Elek. Zeit.*, Oct. 20.

Electrophysics and Magnetism.

Musical Arc Oscillations in Coupled Circuits.—E. TAYLOR JONES.—The author has formerly given photographs showing



Figs. 5 and 6—Arrangements of Contacting Device.

the variation of potential at the terminals of the secondary of a pair of coupled circuits when the two oscillations of the system are simultaneously maintained by a musical arc connected to the primary. In these experiments the circuits were so adjusted that the frequency of one of the oscillations corresponded either to one of the harmonics of the other or to the perfect fifth above it. It was pointed out in the latter case that it was necessary that the two notes of the system should be equally stable in order that the double oscillation curve might be produced, and that the note when heard was an octave below the lower of the two primaries, being in fact their difference in tone. The author has now extended the investigation to some of the smaller intervals, where he finds similar conditions to hold, although there are some differences. —*Phil. Mag.*, October.

Zeeman Effect.—P. ZEEMAN AND B. WINAWAR.—A third paper on the magnetic splitting of absorption lines and its relation to the spectrum of sun spots.—*Phys. Zeit.*, Oct. 15.

Rays of Positive Electricity.—J. J. THOMSON.—His full paper on an experimental study of rays of positive electricity presented before the British Association, an abstract of which has already been noticed in the Digest.—*Phil. Mag.*, October.

Canal Rays.—E. GOLDSTEIN.—A description of some simple arrangements for the production of canal rays.—*Phys. Zeit.*, Oct. 15.

Electrochemistry and Batteries.

Fixation of Atmospheric Nitrogen.—F. HABER, A. KOENIG, E. PLATOU, W. HOLWECH AND A. WOLOKITIN.—Five papers dealing with different problems involved in the fixation of atmospheric nitrogen. Haber, Koenig and Platou report on experiments made with a high-tension arc with artificial cooling. The first series of experiments was made with direct-current arcs, the object being the determination of a maximum concentration at reduced pressures. The arc was produced in a fused-quartz tube, water-cooled from the outside. The curve of concentrations produced shows a decided maximum (8.16 per cent NO) at an atmospheric pressure of 150 mm mercury (voltage, 1400; current, 0.27 amp). In a second series of experiments the authors determined the apparent phase difference in an alternating-current arc and the yield obtained. With a power consumption of 0.7 kw, with a concentration of 3.4 per cent NO, 57 grams HNO_3 were obtained per kw-hour; this gives a yield of 500 kg HNO_3 per kw-year. In view of the high concentration this figure is fairly satisfactory. Holwech and Koenig show that with a changed experimental arrangement, using direct current, they were able to obtain yields of 80 grams HNO_3 per kw-hour, with a concentration of almost 2.5 per cent NO. High-frequency alternating-current discharges were employed in experiments of Haber and Platou. The frequency does not have any great influence on the yield as long as proper precautions are taken. Experiments with increased pressure were made by Haber and Holwech, but no improvement of the yield was made. Wolokitin studied the formation of nitrogen oxides in the hydrogen flame. The following figures are given on the yields now obtained in European commercial plants: 50 grams to 75 grams HNO_3 with a 1.0 per cent to 2.5 per cent concentration of NO_2 and NO with preheated air. If the air is not preheated the "horn" discharge apparatus yields 50 grams HNO_3 per kw-hour.—*Zeit. f. Elektrochemie*, Oct. 1. Abstracted in *Met. and Chem. Eng'ing*, November.

Modified Cyanide Process.—J. C. CLANCY.—An account of a modified cyanide process in which cheaper materials instead of sodium or potassium cyanide can be used. The author employs especially calcium cyanamide which is made in the electric furnace and which has heretofore been used as a fertilizer only. A solution of calcium cyanamide can be made an effective solvent for precious metals if at the same time electrolysis is employed.—*Met. and Chem. Eng'ing*, November.

Electric Steel.—An illustrated description of the first Norwegian steel works using an electric furnace for steel melting. This is the plant of A. Hiorth, who employs a double induction furnace, with a larger compartment in the center. The capacity is 5 tons to 6 tons.—*Elek. Anz.*, Oct. 13.

Units, Measurements and Instruments.

Electromagnets.—E. JASSE.—Continuation and conclusion of his paper on the calculation of electromagnets. In the present instalment the author gives the formulas for special designs of magnets, both rotary magnets and lifting magnets.—*Elek. u. Masch.* (Vienna), Oct. 9 and 16.

Calibration of Optical Pyrometers.—G. A. SHOOK.—While for the calibration of optical pyrometers a "black body" is needed as a primary standard, yet for ordinary use a simpler secondary standard is preferable. The author recommends the use of wide-filament incandescent lamps as secondary standards. If a pyrometer lamp is aged at 1900 deg. C. for about twenty hours it will remain sufficiently permanent for the most accurate work for about fifty hours.—*Phys. Review*, October.

Alternating-Current Measurements.—The first part of an article of an elementary nature, illustrated by diagrams, on alternating-current measurements, dealing especially with instruments of the electrodynamometer type and electrometers. The article is to be continued.—*Elek. Anz.*, Oct. 16.

Laboratory Resistances.—M. SIEGBAHN.—An illustrated description of some forms of simple resistors for laboratory use. The author has found water-cooled manganin wire very useful. While manganin wire of 11.4 ohms per meter in air cannot stand more than 1 amp it stands 5 amp when water-cooled. Another type of laboratory resistor makes use of thin carbon rods.—*Phys. Zeit.*, Sept. 15.

Telegraphy, Telephony and Signals.

Transmission of Pictures.—B. Glatzel.—The first part of a paper describing new experiments on the electric transmission of photographs and pictures. In the transmitter a method of compensating for the inertia of a selenium cell is employed. In the receiver a special "light relay" is employed. The latter, as used by Korn, is shown in principle in Fig. 7, in which *N.S.*

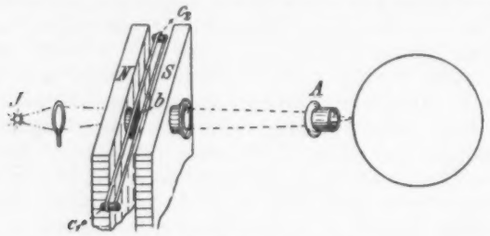


Fig. 7—Picture Transmitter.

are the two poles of a strong electromagnet. The light from a Nernst lamp *J* passes through holes in the poleshoes. In the magnetic field a loop consisting of two thin copper ribbons c_1 c_2 is provided. The current passes through both ribbons in parallel and the two ribbons can be more or less stretched. This loop c_1 c_2 has at its center a small rectangular piece of mica. The light of the lens falls on a screen. When the loop c_1 c_2 is at rest no light falls through the lens. But when a current passes through c_1 c_2 the piece of mica is deflected and more or less light falls through the lens upon the screen. The deflection is the greater the greater the current. Evidently the arrangement is simply a relay, so that the illumination at the receiving end is entirely independent of that at the transmitting end. The paper is to be concluded.—*Elek. Zeit.*, Oct. 20.

Electric Clock.—Clocks controlled by conical pendulums are not so exact in regulation as those having the ordinary swinging pendulums. There are, however, many cases, such as the driving of astronomical equatorials, registering chronometers, seismographs, etc., for which a very uniform and continuous motion is required, combined with a considerable torque, and for these cases the intermittent to-and-fro motion of the ordinary pendulum is not suitable. To meet such cases an improved electric clock, controlled by a powerful conical pendulum, has been devised by R. Thury. It is shown in Fig. 8. This is a master clock, from which any number of secondary clocks can be operated in exact synchronism. It consists of a motor-generator with fixed slotted Gramme-ring armature below and is driven from some outside source, such as a storage

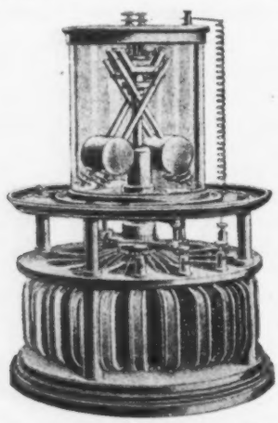


Fig. 8—Thury's Electric Clock.

battery. Inside this armature a soft iron electromagnet is arranged to rotate, and this drives the main vertical clock spindle. This magnet carries two independent windings—one for the main excitation and the other as a regulating excitation. Two collector rings attached to the spindle serve to carry the current from the battery both to the main magnet-exciting winding and to the stationary armature through a pair of adjustable revolving brushes rubbing on the stationary commutator of the armature. The double-crossed-arm conical pendulum is attached to the upper part of the vertical spindle, as shown. It is arranged to be synchronous over a considerable angle. The upper part of the pendulum rods acts as an adjustable contact maker, which serves to make or break the circuit of the auxiliary regulating winding on the magnet. As soon as the pendulum bobs open out beyond a certain angle the contact is broken and the current cut off from the auxiliary winding. As this auxiliary winding is arranged to act in opposition to the main winding, this increases the field strength of the motor, and thus slows it down. The heaviness of the bobs prevents any appreciable speed fluctuations occurring between two successive regulations. The current broken at the contacts is kept very small so as to avoid sparking. Three equidistant tappings are taken out from the stationary armature winding, and these form the generator part of the motor-generator, and serve to provide the polyphase alternating current used to drive the secondary clocks. Three wires, or two wires and an earth connection, join the master clock to the whole of the secondary clocks for this purpose. The secondary clocks contain merely a simple synchronous motor consisting of two stationary armature coils and a permanent magnet rotating within them in exact synchronism with the supply current. The actual speed of the secondary clocks can be given any desired value by varying the number of poles in the synchronous motor. If two-phase or three-phase currents do not give a sufficiently constant turning movement it is an easy matter, by means of transformers, to produce a six-phase supply.—*Zeit. f. Schwachstromtechnik*, No. 5; abstracted in Lond. *Elec. Review*, Oct. 21.

Bookkeeping.—G. Johnson.—The first part of an article on the bookkeeping and accounts of telephone undertakings. Numerous blank forms are given as illustrations.—Lond. *Elec. Review*, Oct. 21.

Miscellaneous.

Metals Used in Electrical Industry.—W. Fellenparg.—A continuation of his long serial on the development of electrical engineering in the United States and Germany. In the present instalment he gives statistical data on the production and consumption of copper, zinc, lead, tin, silver, aluminum, nickel, mercury, antimony, manganese and platinum.—*Elek. Zeit.*, Oct. 20.

Book Reviews.

Electrical Engineer's Pocketbook. Tenth edition. Edited by William H. Fowler. Manchester: Scientific Publishing Company. 566 pages, illus. Price, 2s. 6d.

The title of this book is somewhat ambitious, and although the book contains many valuable data along certain lines, it would not be advisable for an electrical engineer to go into the wilderness to build a plant with only this book for reference. The subject is divided roughly as follows: Tables, magnetism, conductors and insulating materials, wiring, resistance measurements, electrical instruments, batteries, direct-current and alternating-current machinery, transformers, switchboards, electric traction, rules and regulations. The section on conductors and insulating materials contains many useful data arranged for ready reference. The portions of the book which deal with heavy electrical engineering are too brief to be of much value. The measurement of resistance, the subject of magnetism, the laboratory measurements of electric quantities, etc., receive a more or less detailed treatment. The character of the book is not adapted to the needs of the American electrical engineer; for instance, the subject of power transmission occupies less than two pages and of that about half is devoted to the Thury direct-current system.

THE FOUNDATIONS OF ALTERNATE-CURRENT THEORY. By C. V. Drysdale. New York: Longmans, Green & Company. 300 pages, 190 illus. Price, $2.50.

The flow of electricity and the general relations of the energy factors in simple electric circuits are explained by aid of mechanical analogies. These analogies are carried out in great detail and occupy the greater share of the book. The scope of the book includes the circuit constants: resistance, inductance and capacity; the treatment of series and parallel circuits; the elementary theory of mutual inductance or the transformer. Hysteresis, eddy currents and the theory of electrical apparatus are not touched upon. The book is inteded merely as an introduction to advanced treatises on the subject, and as such it serves well its purpose. It should give the student a physical conception of alternating-current phenomena and therefore make it possible for him to follow with a better understanding the theory of electrical machines and circuits when studied mathematically.

PRACTICAL DYNAMO BUILDING FOR AMATEURS. Construction and winding of an experimental 50-watt dynamo. By Arthur J. Weed. New York: The Norman W. Henley Publishing Company. 82 pages, 64 illus. Price, $1.

Detailed instructions are given for building a small direct-current machine, most of the work to be done on a small lathe. The successive operations are clearly illustrated, thus greatly facilitating the understanding of the methods of carrying on the work. The author states that he has had considerable experience in building small machines and the one which is here described has been extensively built and represents good practice.

PROCEEDINGS NATIONAL ELECTRIC LIGHT ASSOCIATION. Thirty-third convention, 1910. New York: National Electric Light Association. 2 vols., 2070 pages, 483 illus.

These two volumes include the report of the thirty-third convention of the National Electric Light Association, held at St. Louis last May, and mark the twenty-fifth anniversary of the association. The volumes include 2070 pages and 483 illustrations, among the latter being a fine portrait of President Frueauff and several elaborate colored engravings in the paper on "Street Arcs," by Mr. W. D'A. Ryan. The volumes embrace some seventy papers and committee reports, all of which are briefed in an index for ready references. A year ago the edition was 4500 sets. This year, owing to the rapid increase in membership, the edition reaches 7000 sets and represents about 28 tons of printed matter. The publication this year is ahead of the usual date.

New Apparatus and Appliances

PRACTICAL PERFORMANCE OF ELECTRIC COMMERCIAL VEHICLES.

In the accompanying illustrations are shown two veteran electric trucks which took part in a commercial-vehicle contest held in New York City on Oct. 28 and 29. The "Mary Ann" was the first truck built by the General Vehicle Company nine years ago, and the Daussa truck was built by the same company seven and a half years ago. Although neither of these trucks is ordinarily called upon to cover more than twenty-five miles, each covered thirty miles on the first day of the contest and ended in creditable order.

Fig. 1—Electric Truck Nine Years in Continuous Service.

Fig. 2—Electric Truck 7½ Years in Continuous Service.

Of the forty entries in the contest twenty-four were electric vehicles; seventeen of these were General Vehicle Company machines, of which fifteen were entered by the owners and two by the manufacturers.

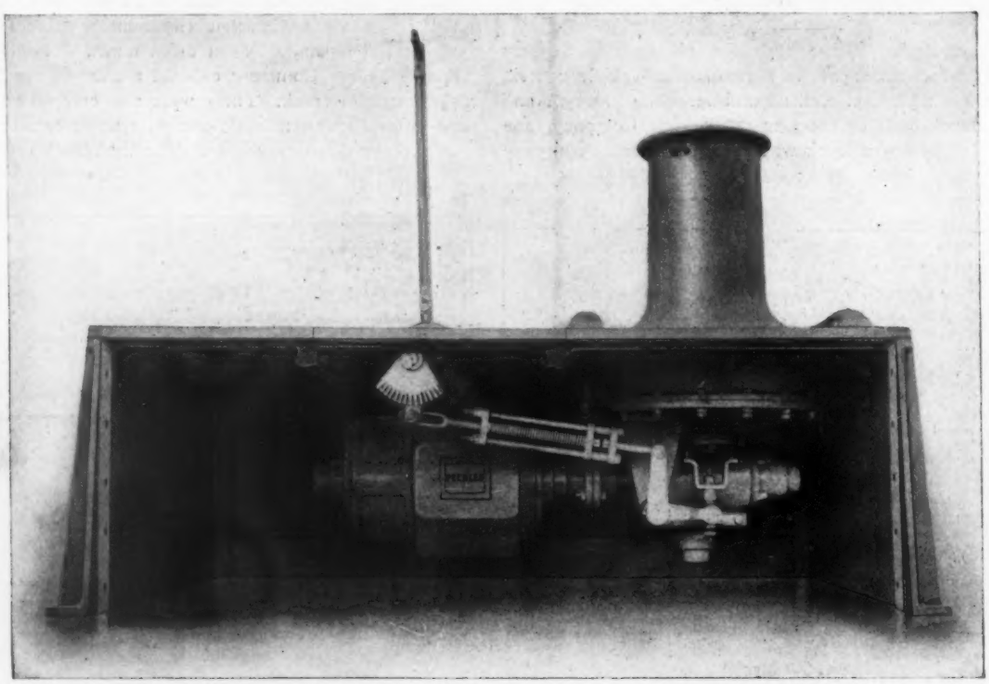
The New York Edison Company entered five machines, a 1000-lb. lamp wagon, a 2000-lb. repair wagon, a 2-ton freight truck, a 3½-ton pole-hoisting truck and a 5-ton cable-winch truck. The Edison Electric Illuminating Company, of Brooklyn, entered a similar 5-ton cable truck. The United Electric Light & Power Company entered a 2000-lb. repair wagon and a 3½-ton cable truck. There were also entered by the owners a 2000-lb. bread wagon, a 3½-ton milk truck, two beer trucks and one package-delivery wagon. The manufacturer of the above trucks, the General Vehicle Company, entered a 3000-lb. furniture wagon which easily covered the required sixty-five miles on one charge, and a 1000-lb. vehicle which carried its full load for sixty-five miles and after the finish of the run officially made a total of 87.6 miles without exhaustion, thereby showing that the modern electric commercial vehicle can readily cover all the mileage that is needed in a working day. It is said that all of the standard General Vehicle trucks of recent design made perfect scores on both days of the contest.

Among the trucks entered by owners were one 1500-lb. Chicago Vehicle, two 1000-lb. Lansden wagons and one 3000-lb. Commercial. Among the manufacturers' cars were a 1000-lb. Lansden wagon in the transfer class and a 1500-lb. Lansden in the distributing class.

Among the manufacturers' cars the winner in the transfer class was a 1000-lb. General Vehicle at a cost of 2.53 cents per ton-mile and the winner in the distributing class was a 1500-lb. Lansden at a cost of 1.06 cents per ton-mile. Among the owners' cars the winners were as follows: A 1000-lb. General Vehicle, cost 1.08; a 2000-lb. General Vehicle, cost 0.84; a 3000-lb. Commercial, cost 0.48, and a General Vehicle, cost 0.40, the costs being in cents per ton-mile for the electricity consumed, with energy at 4 cents per kw-hour. It is noteworthy that the cost of fuel and engine oil for the competing gasoline cars averaged 46 per cent higher than the energy for the electric cars. The maximum variation in cost per ton-mile in any one class for the electric vehicles was only 4.6 per cent, while the gasoline cars in a class varied in cost as much as 214 per cent.

ELECTRICALLY DRIVEN CAPSTAN.

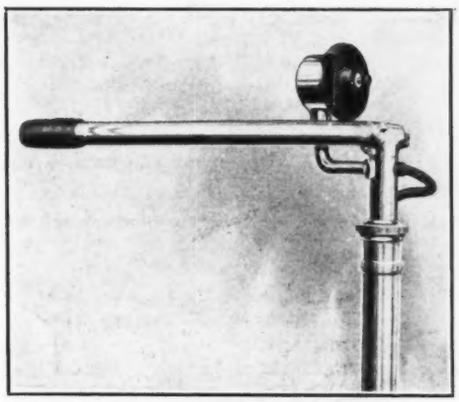
One of the most useful applications of electricity is in connection with the driving of capstans for dockyards, railways, collieries, etc.; installations of this kind having rapidly replaced older forms driven by steam or hydraulic power. The essential requisites of such a device are absolute reliability, efficiency of operation, minimum demand on generating plant and low cost of repairs and renewals of ropes. The chief feature of the capstan illustrated herewith and manufactured by Bruce Peebles & Company, Ltd., Edinburgh, Scotland, is that the head is not fixed to the spindle in the ordinary way, but is revolved by a clutch, sliding on the upper end of the spindle inside the capstan head. By having the head loose on the spindle a wire rope fixed permanently to the head can be used and a positive pull obtained as soon as the head begins to revolve, thus avoiding the heavy losses incurred, especially in hydraulic capstans, when they are revolved without doing work. Moreover, the rope being fixed, there is no slipping and grinding action as in the case of capstans where loose ropes are used. The capstan head and box containing the electrical equipment, gearing, etc., are of ribbed cast iron, a watertight manhole being provided on the top of the box to allow of ready access being obtained to the interior for inspection and repair. The box is arranged to be set flush with the ground, and the provision of a concrete pit beneath the capstan is advisable, so as to allow ample room for access to the working parts. The capstan head has a large spur wheel attached to it, which is driven from a pinion mounted on a worm-wheel shaft, the motor being direct-coupled to the worm shaft. The worm has a triple thread of wrought iron, and gears into a phosphor-bronze wheel having ball thrust bearings, the whole running in an oil bath and being provided with a dust-tight cover. Both the pinion and spur wheel are machine-cut steel, and are also inclosed in an oil bath and provided with a dust-tight cover. The motor is of the series-wound type, and the motor, controller, main switch, and fuses are totally inclosed and mounted on one side of the iron containing-box, the controller being actuated by a bevel wheel geared to the starting and controlling lever. The starting lever is worked through the top of the case, and is arranged in such a way as to be quite watertight, it being possible to insert and remove the handle only when the controller is in the off position. With each capstan are included a main switch and pair of fuses, two lamps also being provided for the convenience of the attendant as well as to keep the atmosphere slightly warmed, which had been found of great advantage with the capstans already installed. All the necessary internal wiring is provided between the different portions of the apparatus, so as to make the whole complete in every respect, ready for connecting up to the supply cables. In operation, the starting lever is first inserted and moved over to the starting position which actuates the controller and starts the motor, the power from which is transmitted through the worm and spur gear to the capstan head, to which the hauling rope is permanently attached. At the top, and inside the capstan head, is a clutch which is thrown out of gear by moving the lever in the reverse direction to that necessary for starting; this clutch is always in gear except when the lever is thrown over in the position mentioned when the capstan head is free to revolve. Should it be desirable to reverse the direction of rotation, this can readily be done by moving the starting handle over beyond the "clutch out" position. The above description refers to a capstan with "handle" type control, but the operation is exactly similar if the "lever and pedal" type be adopted, excepting that the control gear is simplified by the omission of the tension spring referred to above, the clutch in this latter case being actuated by a separate pedal.



Electrically Driven Capstan, with One Side Removed.

ELECTRIC AUTOMOBILE WITH AUXILIARY CONTROL.

Control of the motor speed through electromagnetic contactors is one of the distinctive features of the Ohio electric automobile. The controller itself is a small enclosed dial switch mounted on the steering lever. This controller closes auxiliary circuits employing small currents, which energize the windings of electromagnetic switches, completing the main motor circuits. The group of contactors is mounted alongside the forward battery under the bonnet. The reverse lever is situated at the side of the seat under the driver's left hand and provision can also be made for securing an extra high speed by manipulation of a foot lever. The motor speed is reduced by silent chain gearing to that of the transmission shaft, which, without a universal joint or other complicating feature, drives the rear axle through bevel gearing. From motor to wheels the entire driving mechanism is enclosed in an oil-tight and dustproof case. The braking action is applied directly to the rear axles by foot power, duplicate sets of regular and emergency brakes being provided. The standard of construction of the chassis frame approximates the superior steel design employed in high-grade gasoline cars, but the efficiency of the simple transmission results in easy-running characteristics equal to those of any electric vehicle. The Ohio electric car is built by the Ohio Electric Car Company, Toledo, Ohio.



Controller of Ohio Electric Car.

ALTERNATING-CURRENT ELEVATOR CONTROLLER.

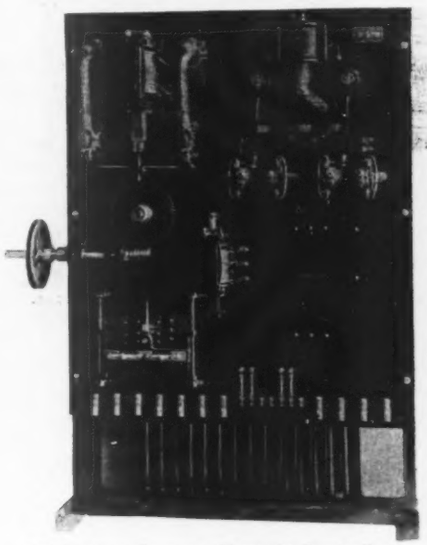
The increasing use in high-class, heavy-duty passenger service of alternating current has created a demand for a magnetically operated system of control from the car switch, thus providing the facility of acceleration obtainable with direct current. To meet this requirement the Automatic Switch Company, of New York, has developed a modification of its motor-driven starter and special magnet-reversing switches, which is illustrated in the accompanying engraving.

In the cut in the lower left-hand corner of the panel is shown a motor-driven magnetically clutched starting device. This starter is driven by a belt from the motor itself and is arranged to cut out nine steps of resistance in the rotor, the steps being staggered to increase their number. When the magnet on this starter is energized by current from the main line switch, the revolution of the worm wheel imparts through the clutching mechanism a movement to the horizontal resistance arm, which in its upward movement cuts out one after another the various steps of resistance in series with the three leads from the collector rings.

Immediately above the starter is shown the double-pole main line switch, which, by reason of its toggle movement, requires comparatively small energy in the magnet to insure firm seating of the contacts. These contacts consist of alternate copper and carbon buttons.

To the right of the main switch is shown the Darrin magnet reversing switch, which has current in its magnet coil during only the actual operation of throwing from one direction to the other, thus removing all heating and noise from this coil.

Means for preventing the closing of the main-line switch until after the reversing switch has taken a position to correspond with the position of the car switch and until after the resistance arm has fallen to its lowest position are provided so as to prevent the possibility of opening the circuit on the reversing switch, or of closing the main line with any resistance cut-out of rotor. The resistance is of the Whittingham tubular sand-packed type, mounted on angle-iron frame at the back of the panel, so as to leave the wiring at the back of the board exposed to facilitate examining the circuits. Only two magnets are energized when the motor is in operative condition, as the reversing magnet carries current for only an instant. The accompanying illustration shows an equipment now being installed in the State Capitol at Hartford, Conn., by the Springfield Elevator & Pump Company. Four similar equipments have recently been installed in the new laundry building of the Manhattan State Hospital at Blackwell's Island; two of the latter are automatic in that they are operated by push buttons to bring the car to the landing and to send it to another landing.



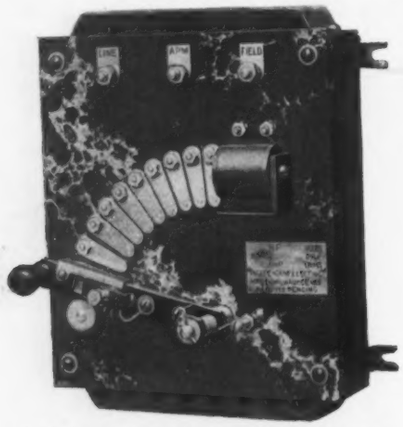
Alternating-Current Elevator Controller.

RHEOSTATS WITH CAST-IRON BOXES.

The Independent Electric Manufacturing Company, of Milwaukee, Wis., is making a new line of controlling devices for both direct current and alternating current. The accompanying illustration shows a motor starter (with underload release), and the company also makes speed regulators, field rheostats and solenoids. A feature of this apparatus is the care used in material and workmanship to make the rheostats rugged and fireproof. The resistance box is made of gray-iron castings and is so designed, with ventilating holes at the top and bottom, that the projections providing for these ventilating apertures also constitute receptacles. Should a resistance unit burn out the melted solder or glowing wire will fall into the lower receptacle and be retained there without any danger of setting fire to inflammable material by which the resistance box may be surrounded. Thus there can be no outburst of flame or molten material from the interior of the box. The resistance units consist of moisture-proof asbestos tubes wound with German silver or iron wire, the tubes being provided with porcelain tips. The front of the box is made of marbleized slate, and all starters and regulators have removable segments and sliding

brushes. With the exception of the wooden handles and the insulation of the magnet wire, all parts of the resistance are of fireproof material.

The ventilating apertures referred to allow a current of air to enter the bottom of the box, pass up and around the resistance tubes and out at the top, thereby providing an effective system of ventilation and prolonging the life of the resistance units. The company makes several types of rheostats. One is of automatic design, with a "no-voltage" release, which allows the lever to swing automatically to the "off" position when the current is interrupted. There is also an automatic type with underload and overload release, which is the same as the no-voltage design with the addition of a solenoid, which allows the handle to swing automatically to the "off" position when a predetermined overload exists which would be dangerous to the motor. Either of the automatic types is furnished mounted on a slate panel with knife switches and fuses, making a complete electric controlling device. Field regulators are also made in open and iron-clad types for the front or rear of switchboards.



Motor Starter with Underload Release.

ELECTRIC RANGE.

The domestic electric range shown in the accompanying illustration, which has been recently perfected by the General Electric Company, is patterned after the ordinary gas range, and cooking, it is stated, can be done with it as quickly as with gas or coal, owing to the fact that the heating elements are made of "calorite," a new alloy discovered by the same manufacturer after years of investigation in its research laboratories.

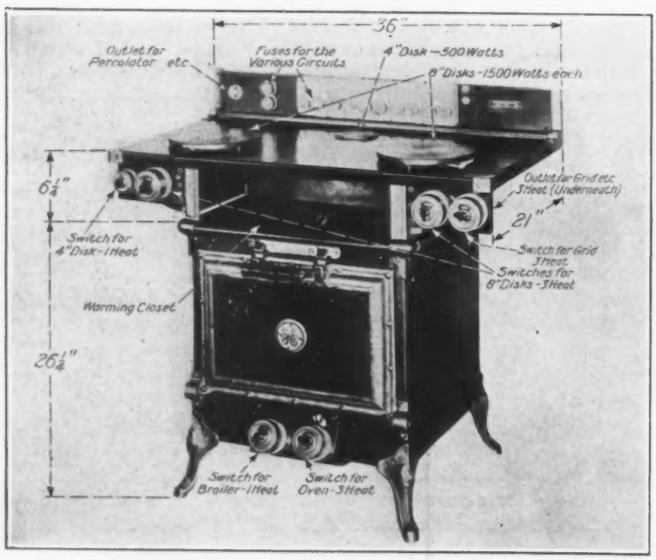


Fig. 1—Domestic Range, Showing Dimensions.

There are three disk stoves on the top of the range designed to be used in the same manner as the burners of a gas range. A turn of the snap switch turns on the heat instantly at full intensity, while another turn cuts it off and so permits the elimination of any expense for energy when the stove is not actually in use, without incurring a delay in getting it into operation again. The two larger stoves are provided with a switch which admits of a three-heat regulation, thus making it possible to get a low, moderate or high heat, as conditions may require. The three stoves permit cooking one, two or three dishes at once.

The combination oven and broiler is commodious, being 18 in. x 18 in. x 12 in. and ample for the needs of a large family, and is provided with heating units at both top and bottom. By removing the ceiling plate of the oven the top heating element of the latter is exposed and may be used as an overhead radiant broiler, or for the purpose of producing a pronounced browning of pies, biscuits, roasts, etc. The ceiling plate can be used as a shelf to support the broiling pan at the proper distance below the heating element. The slide supports on the side of the oven permit vertical adjustment of the broiling pan and oven shelves, and also the use of several shelves at once. The broiling pan (which is furnished with the range) is also suitable for use as a roasting pan. Printed instructions accompany each range, and tell what "heat" to use and how long to leave it on to bake or roast the various kinds of meat, bread, cake, pie, etc. The stoves, broiler and oven all have independent controlling switches. It is said not to be necessary to use a thermometer with this oven, as the temperature attained at the various positions of the switch for the intervals of time stated in the instructions accompanying the range will be best suited for each case.

Fig. 2—Domestic Range, Showing Interior of Oven.

The space between the stove top and the oven is heated indirectly from the oven, broiler and stoves, and so makes a convenient plate and food warming closet. To increase the usefulness of the range two additional outlets are provided for individual electrically heated devices, one being an outlet for a percolator, etc., of one heat and not over 600 watts, and the other an outlet for a grid or other three-heat electric device, a three-heat switch being mounted on the range for its control. The equipment of the range is as follows:

Two 8-in. disk stoves, 375-1500 watts, three-heat switch; one 4-in. disk stove, 500 watts, one-heat switch; one broiler, 1600 watts, one-heat switch; one oven, 575-1150-2100 watts, three-heat switch; one warming closet, indirectly heated.

The circuits to each part of the range are separately fused by a double-pole fuse block, while a main fuse of 60-amp capacity protects the entire range. The wiring is arranged for either two-wire or three-wire connection. The range is of sheet-metal construction and finished with nickel trimmings.

Industrial and Commercial News

THE WEEK IN TRADE.

COLDER and more seasonable weather had the effect of stimulating retail trade to some extent last week. The improvement, however, was not sufficient to cause any great amount of boasting. Among the wholesalers and jobbers the improvement is one of sentiment rather than of actual trade. Re-orders are coming in very slowly, but the majority of dealers believe that after election there will be something almost like a rush of Christmas orders. While heavy frosts were reported over much of the producing section within the last week, the crops were so well gathered that very little damage was done. In fact, the crops all over the country have been harvested unusually early and have been marketed with unusual celerity. This has added to the ready money throughout the entire agricultural district, and has done something toward stimulating retail trade. Relatively the best reports as to retail trade come from the central West and South. Trade in Eastern centers has been fair, but not as good as in the agricultural districts. The labor troubles in New York City have caused some congestion in the movement of freights. In the industrial world there is very little change. The most noteworthy occurrence of the week in the iron and steel industry was the order of 33,000 tons of rails by the Erie Railroad. This is the first considerable order of rails that has been placed, but it is well known that other railroads have prepared specifications, and orders may be expected between this and the end of the year. There is very little doing in the way of structural material and export trade is distinctly slow. Collections throughout the West are considerably improved, although in Eastern centers they are very little better. Business failures for the week ending Nov. 3 were 179, against 220 the previous week, 212 in the same week of 1909, 205 in 1908, 226 in 1907 and 146 in 1906.

THE COPPER MARKET

ACTIVE speculation in standard copper did much to liven up the market last week. There was quite an aggressive buying movement of future deliveries for the London market. Dealers here sold heavily and on several days covered their speculative sales by purchases of electrolytic for December and January shipments. The total sales of this character were reported during the past week to be between 15,000,000 lb. and 20,000,000 lb. There were also a few orders placed by domestic consumers for electrolytic copper at prices ranging from 12.70 cents to 8.80 cents cash for January shipment. It is a notable fact, however, that consumers both in this country and in Europe are showing very much less interest in the market than are the speculators. Those who believe that the copper market is still in an unsatisfactory condition are charging that statistics are being manipulated in order to make appearances favor higher prices. By some of the market experts it is said that the present speculative movement and the present advance in prices are due to a belief that the Copper Producers' Association's report in October will be extremely satisfactory. While the figures for this month have not been given out at the time this report is written, it is understood that they will show a very considerable reduction in the rate of production. This is due to the curtailment policy which was put into effect in August and September and which is just beginning to show in the monthly reports of the association. It is not believed, however, that the takings, either domestic or foreign, will appear very large. The sum total of the report will not show much change in the amount of surplus stock being carried from the report of the previous month. There may be a slight increase or there may be a slight decrease. Imports of copper remain about at the same average that has prevailed since the beginning of September. Exports are not particularly heavy, and for the first five days of November were 2374 tons. The daily call on the Metal Exchange Nov. 5 quoted standard copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	price.
Spot	12.40	12.60	....
November	12.40	12.60	12.50
December	12.40	12.65	12.52½
January	12.50	12.70	12.60
February	12.70	12.75	12.72½

The London market Nov. 4, was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	57 13 9	57 18 9
Standard copper, futures	58 13 9	58 17 6

Extreme fluctuations for this year:	Highest.	Lowest.
Standard	13.50c	11.70c
London, spot	£62 0 0	£52 15 0
London, futures	65 18 9	53 7 6
Best selected	65 10 0	57 15 0

INDUSTRIAL AND COMMERCIAL NOTES.

Queens Borough Gas & Electric Company.—The Public Service Commission of the First District of New York received a letter last week from Carleton Macy, president of the Queens Borough Gas & Electric Company, which operates in the Far Rockaway district, making a proposition to the commission to have its experts make a thorough examination of the company's books and make a maximum rate for both gas and electricity for the year 1911. This is the first time a request of this kind has been received by the commission from any corporation. The company now charges $1.30 per 1000 cu. ft. for gas and 18 cents per kw-hour for electricity. Two complaints were filed with the commission last spring, each signed by one hundred consumers, one against the price for gas and the other against the price for electricity, asking that a readjustment of rates be made. Quite a number of hearings have been held on these complaints and expert accountants have made a thorough examination of the company's books in order to determine what would be a fair return for the investment. In his letter to the commission asking for the fixing of rates Mr. Macy says that the expenses attending the inquiry made by the commission have amounted to almost the entire net earnings of the company for the year 1910. Mr. Macy says that asking the commission to fix the rates is a policy that has been adopted as a measure of economy. No action has been taken by the commission as yet. It is probable that it will accept the offer of the company and in that case the cost of any inquiry to be made in the future as to the cost of the production of gas and electric energy will fall upon the commission and not upon the company.

Mexican Northern Light, Heat & Power Company.—M. F. Greenwood, president of the Mexican Northern Light, Heat & Power Company, has recently returned from a trip of inspection of the development which is located on the Conchas River in the northern part of Mexico. Mr. Greenwood says that a branch railway has been constructed from the main line of the Mexican Central to the site of the power station, a distance of about twenty miles. This has facilitated the movement of machinery and supplies. The dam which the company is building is well under way and the work is being rapidly pushed forward, the company having at present more than 1000 men employed. The progress of the work is at this time ahead of the engineers' schedule and is about one-third completed.

General Electric and National Carbon.—At the New York offices of the General Electric Company specific denial is made of the report which has been printed in the West to the effect that the General Electric Company was about to take over the National Carbon Company. It is said that there is absolutely no truth in this, and that there is no deal on between the two companies. This report gained credence in the Chicago market as an explanation of the sudden and rather remarkable rise in the price of the Carbon Company's stock. The National Carbon Company's common stock sold last week at 145. The stock has been steadily advancing for the past two years. On Jan. 1, 1909, the stock was quoted at 82. On Jan. 1 of last year it was quoted at 108.

McAdoo Tubes Open.—The Hudson & Manhattan Railroad Company will open Nov. 10 its system as far north in Manhattan as Thirty-third Street. While it is intended that the road shall eventually be extended to the Grand Central Station, it is likely that the station at Thirty-third Street will be the most northern terminal for some time to come. At the meeting of the board of directors of the company last week C. W. King was retired as secretary, and William Everdell, Jr., was elected to fill the vacancy. W. J. Martin was retired as assistant secretary, and Kenyon B. Conger was elected to that position.

Philadelphia Electrical Credit Association.—The fifteenth annual meeting of the Electrical Credit Association was held at Hotel Walton, Philadelphia, on the evening of Nov. 3, 1910, and, notwithstanding the severe storm, forty-five members of a total of sixty-six were present, as well as guests from Washington, Pittsburg, New York, Wilkes-Barre, Scranton and Trenton. Antoine Bournonville, of Alfred F. Moore, the retiring president, made a brief but pointed address, assuring the association of his unabated interest in the work. William T. Pringle, of the Pringle Electrical Manufacturing Company, and C. Ross Smith, of the Westinghouse Electric & Manufacturing Company, were elected members of the executive committee to succeed Mr. Bournonville and F. E. Stow, of the H. C. Roberts Electric Supply Company. Immediately following this election a short session of the executive committee was called and H. G. Kepler, of Walker & Kepler, was elected president, and L. R. Browne, of the Western Electric Company, vice-president. The annual report of John W. Crum, secretary and treasurer of the association, showed a most favorable financial condition. Twelve new members were added to the roll during the year and many testimonials to the value of the association's services were received. Following the business session a silent toast was pledged in water (according to the usual custom of the association) to the memory of the late past-president, Charles E. Trump, of the Novelty Electric Company. An instructive report was given by the association's national delegate, Charles M. Wilkins, of Partrick, Carter & Wilkins Company, covering the last annual meeting of the National Electrical Credit Association.

Telephones for Trains in the Far West.—The telephone method of dispatching trains has lately been adopted on the Shasta division of the Southern Pacific Railroad, where telephone circuits have been installed over 291 miles of road. The new method is being used over a 206-mile section of main line between Ashland, Ore., and Red Bluff, Cal., and a branch of 95 miles from Weed, Cal., to Klamath Falls, Ore. The dispatcher is located at Dunsmuir, Cal., which is 98 miles from Red Bluff, the southern terminal of the circuit. There are twenty-five stations on the entire circuit, twelve being located between Dunsmuir and Red Bluff, nine between Dunsmuir and Ashland and four between Weed and Klamath Falls. This entire circuit is composed of specially drawn 300-pound copper wire, metallic circuit. This telephone line goes through a mountainous region, and wire of extreme weight has been selected, not alone for conductivity but for tensile strength as well. This circuit during sixteen hours out of twenty-four is cut into two sections and during the other third the entire circuit is operated by one dispatcher. The apparatus for this dispatching system has been furnished by the Western Electric Company, which has made more than 90 per cent of the train-dispatching telephones now in use in the United States. Passenger and freight trains on the Southern Pacific are equipped with portable telephone sets, enabling train men to get in touch with the dispatcher from any point along the road.

Western Electric Sells More Property.—The Western Electric Company has sold its Clinton Street property in Chicago to a syndicate composed of William V. Kelly, president of the American Steel Foundry Company, George E. Scott and Robert G. Lamont, vice-presidents of the American Steel Foundry Company, and former Judge Barton Payne. The price paid for the property was about $2,000,000. The holdings represent an original investment by the Western Electric Company of $3,718,316. The company has taken a lease of 500,000 sq. ft. of floor space in the property for the next two years, but will remove the remainder of its manufacturing plant to Hawthorne. Only a few weeks ago the company sold its Polk Street property in Chicago to the Pennsylvania Railroad for $1,800,000. These two sales practically dispose of all of the real estate held by the company in the City of Chicago.

Triumph Electric Company.—It has been announced that the Triumph Electric Company, of Oakley, Ohio, near Cincinnati, will place on the market 2000 shares of its 6 per cent preferred stock, through W. E. Hutton & Company, the Fifty-third National Bank and the Central Trust & Safe Deposit Company, all of Cincinnati. The company is authorized to issue $500,000 preferred stock and of this $275,000 will be issued, including $48,300 outstanding. The common stock authorized is $750,000 and $540,000 of this is outstanding. A large plant has recently been completed at Oakley and a colony formed for the workmen. During the past ten years the financial statement shows net profits of $41,971 annually.

Baltimore-York (Pa.) Trolley Line.—The Pittsburgh Bonding Company is financing a proposed trolley line from York, Pa., to Baltimore. Surveys have already been made and the proposed route will run through Glen Rock, Paradise and Logansville. L. H. Roberts, of New York, is in York trying to interest capitalists in the proposition. It is said that $275,000 will be guaranteed to start the road. The line will be extended to New Freedom, thirty-five miles from Baltimore. For several years there has been a movement on hand to reach Baltimore by way of trolley. But few bridges and cuts are needed over the proposed route. The power of the York Railways Company and the York-Haven Water Power Company will be used.

Want Subway Construction Delayed.—The Public Service Commission of the First District of New York has received communications from the Chamber of Commerce and the Merchants' Association asking that the award of contracts for the construction of the Tri-Borough subway system be delayed until further public hearings can be had. The commission is inclined to take the position that these protests come too late. A civic organization of Brooklyn taxpayers has also expressed its dissatisfaction with the Tri-Borough route and has made a personal appeal to President Shonts of the Interborough Rapid Transit Company asking him to bid for subway construction by private capital.

Laclede Gas Company.—The Laclede Gas Company, of St. Louis, is said to be negotiating with the North American Company for the cancellation of the contract entered into last year for the purchase of energy that will be generated at the proposed hydroelectric development in the Mississippi River, at Keokuk, Ia. The contract obligates the Laclede company to pay a minimum charge of $98,000 a year for ninety-nine years, beginning as soon as the Keokuk company is ready to deliver energy. After investigating the matter thoroughly, the directors of the Laclede company have practically decided that the contract is not an advantageous one, and therefore want it annulled.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at San Francisco, Cal.; Manchester, Ia.; Panama; Eau Claire, Wis.; Marshalltown, Ia.; Albia, N. Y.; Williamsville, N. Y.; Marion, Ala.; Bladen, Neb.; Washington, D. C.; Hurricane, W. Va.; Sullivan, Ill.; Clarkstown, Wash.; Camp Hill, Ala.; Campbellsport, Wis.; Des Moines, Ia.; Newark, N. J.; Burlington, N. J.; Hermiston, Ore., and Roseville, Cal.

Added Facilities at Spartanburg, S. C.—The Spartanburg Railway, Gas & Electric Company, which is owned by the Electric Power & Manufacturing Company, will proceed shortly to increase its facilities and also extend its lines to Gaffney, S. C., twenty miles north, establishing a substation there. Vice-president and General Manager F. H. Knox has returned from a trip to Pittsburgh, where he conferred with the stockholders. The additional equipment will add about 2500 hp.

Long Island Railroad Cars.—The Long Island Railroad Company received last week seventy-five motor and baggage cars. This equipment is a portion of the electrical order that was placed some months ago with the Westinghouse Electric & Manufacturing Company and the Pressed Steel Car Company. The company has just ordered 100 more motor cars in addition to those ordered last spring. The entire order aggregates more than $4,000,000.

Cleveland Electric Illuminating Company.—The Cleveland Electric Illuminating Company has applied for a permit for a new station building on the lake front at Seventieth Street, to cost $850,000. It will be equipped with fifty-six boilers and four turbines. The cost of the equipment will be between $2,000,000 and $3,000,000, it is stated. P. L. Cobb is the architect for the building.

Tri-Borough Bids Tabulated.—The Public Service Commission has concluded the tabulation of the bids which were received Oct. 27 for the construction of the Tri-Borough rapid transit system by city capital. The total of the lowest bids for the twenty-one sections is $85,437,570.

Esperanto for Business Correspondence.—The Standard Underground Cable Company, Pittsburgh, has adopted the Esperanto language for its foreign business correspondence in cases where this can be arranged.

Financial.

THE WEEK IN WALL STREET.

DURING the period immediately preceding the election there was a disposition in Wall Street to transact very little business. While it is not correct to say that the feeling of optimism which prevailed during the early part of October has entirely disappeared, it is certainly true that a great many traders concluded that it was just as well to wait until after the election. There has been less than the usual amount of political turmoil in Wall Street during the present pre-election period. A large proportion of the traders were satisfied in their own minds as to the result of the election, and are not alarmed particularly over the outcome. Still there is always a disposition to hold off at such a time. The total sales for the week which ended Nov. 5 amounted to only 2,513,133 shares. While this is an increase over some of the midsummer business, it is not as large a volume of trading as was anticipated in the fall. One check upon activity has been the advance in rates of interest both in England and Germany. While this has not had a serious effect upon the amount of cash carried in our banks, it has had the effect of making bankers a trifle more cautious. The result of the advance of the discount rate by the Bank of England has been to rapidly increase the surplus of that institution, and the bank is now in a very satisfactory condition. The money market here continues to be fairly easy, although rates are much higher than they were a few months ago. Quotations Nov. 7 were: Call, 2½ @ 4¾ per cent; 90 days, 5 @ 5¼ per cent. The quotations in the table are those of the close Nov. 5.

NEW YORK.

	Oct 31.	Nov. 5.	Shares sold.		Oct 31.	Nov. 5.	Shares sold.
All.-Ch.	9¾	9¾	300	Int.-Met., pf.	57¼	58⅞	17,500
All. Ch., pfd.	32¼	34¼	710	Mackay Cos..	91*	95	1,300
Amal. Cop...	69⅛	71¼	98,800	Mackay C., pf	74*	75½	600
Am. D. T....	20½*	20½*	———	Man. Elev...	142⅛*	143	1,020
Am. Loco....	39¾	40	1,920	Met. St. Ry..	15*	15*	———
Am. Loc.,pfd.	106⅛*	106½	200	N.Y.&N.J.Tel.	139¼*	139¼	———
Am. Tel. & C.	84*	84*	———	Steel, com....	78¼	81	743,890
Am. T. & T..	141	142⅞	26,839	Steel, pfd....	117⅜	118½	9,900
B. R. T.....	76⅞	77¾	12,750	W. U. T.....	72	73	3,400
Gen. Elec....	154	154⅞	3,700	West'h, com..	72¾	73½	4,600
Int.-Met.	22	22⅜	18,150	West'h, pfd..	124*	124	100

PHILADELPHIA.

	Oct. 31.	Nov. 4		Oct. 31.	Nov. 4
Am. Rys.....	43*	43*	Phila. Elec.....	15½	15⅜
Elec. Co. of A....	11⅝*	11¾	Phila. R. T.....	16	15½
Elec. St. B'ty.....	49*	49½	Phila. Trac.....	81	81
E. S. B'ty, pfd.....	30*	30*	Union Trac.....	39⅝	39

CHICAGO.

	Oct. 31.	Nov. 4		Oct. 31.	Nov. 4
Chi. City Ry.....	170*	170*	Chi. Tel. Co.....	120*	123
Chi. Rs., Ser. 1.....	79	76	Met. El. Co.....	21*	21*
Chi. Rs., Ser. 2.....	21	20¼	Met. El., pfd.....	61*	65*
Com. Edison.....	114¾	116	Nat'l Carbon.....	145	143*
Chi. Subways.....	5	5*	Nat'l Car, pfd.....	119*	123*

BOSTON.

	Oct. 31.	Nov. 5		Oct. 31.	Nov. 5
Am. T. & T.....	141	142½*	Mex. Tel.....	5¾*	5¾*
Cum. Tel.....	143*	150*	Mex. Tel., pfd.....	6*	6¾*
Edison E., Ill.....	267½	274½*	N. E. Tel.....	136	137¼*
Gen. Elec.....	154	155½	W. T. & T.....	17*	18*
Mass. E. Ry.....	19¾	20⅜*	W. T. & T., pfd....	89*	90*
Mass. E. Ry., pfd..	84¾	85½*			

*Last price quoted.
Shares sold for week Oct. 31 to Nov. 4.

FINANCIAL NOTES.

New York, New Haven & Hartford Railroad Company.—The annual report of the New York, New Haven & Hartford Railroad Company for the year ending June 30, 1910, which was made public last week, shows that the gross earnings of the company were $60,693,668 and the net earnings $22,004,452. In this report the Connecticut Company, which holds the electric properties in Connecticut, shows net earnings of $2,873,086 and the Rhode Island Company, which holds the electric properties in Rhode Island, net earnings of $573,565. The Housatonic Power Company shows net income of $102,651. The report states that during the year there was completed 6000 ft. of four and six-track single-phase electrification in the vicinity of Glenbrook, Conn. One electric freight locomotive was received, which, the report says, has proved more than adequate. It is also announced that surveys have been completed for the main line and yards on the Harlem River branch and for the electrification of the main line between Stamford and New Haven. Plans for the rehabilitation of the Warren power station and the elimination of the direct-current machinery have also been completed and it is stated that requisitions have been placed for multiple-unit equipment for the line operating between Providence, Fall River and Bristol. At the stockholders' meeting the election of T. De Witt Cuyler, representing the Pennsylvania Railroad, to the board of directors was ratified and the membership of the board was increased from twenty-five to twenty-seven by the election of A. S. May and A. E. Clark, respectively treasurer and secretary of the company.

Allis-Chalmers Report.—The annual report of the Allis-Chalmers Company for the fiscal year which ended June 30, 1910, shows operating profits of $2,576,819. This is an increase over the previous year of $767,810. The balance left applicable to dividends on the preferred stock, which amounts to $16,050,000, is equal to 3.7 per cent. This is compared with .84 per cent of the preceding year. The company's total surplus at the close of the year was $1,017,161. In his report to the stockholders President W. H. Whiteside says: "While there has been an improvement in the earnings of the company during the fiscal year as compared with the preceding period, the various works have been operated at less than 60 per cent of their present capacity, due to the unsettled business conditions of the country. There has been a very small demand for heavy machinery, which has restricted the company's operations largely to the lighter lines and thus necessitated considerable development of new lines and types of the smaller machinery, for which there has been a fair demand. The unsettled conditions referred to have disappointed the expectations expressed in our last report, but the company feels that it is now better able to cope with them, due to readjustments and improvements in methods made possible by important additions to the West Allis works." At the annual stockholders' meeting, held Nov. 3, the old board of directors was elected with the exception that Frank O. Wetmore was elected to succeed William W. Allis, who retired.

Rockingham Power Company.—The sale of the property of the Rockingham Power Company, which has a partially completed hydroelectric development at Blewitt Falls, on the Pee Dee River, North Carolina, will take place some time in the latter part of this month. The sale of the plant was advertised for Oct. 5, but was postponed at that time because there was no bidder. The upset price was then fixed at $1,000,000. This price has now been reduced to $750,000. Dr. W. Gill Wiley, president of the Southern Power Company, recently inspected the site at Blewitt Falls, but an official of the Southern Power Company denied last week that his company was negotiating for this property.

Vermont Companies Elect Officers.—At the annual meetings of the stockholders of the Consolidated Light Company and the Vermont Power & Lighting Company in Montpelier, Vt., last week, the following officers were elected: A. D. Bennett, of Port Huron, Mich., president of the Consolidated; A. W. McLimont, of Jackson, Mich., vice-president; Kirk Lathrop, of Detroit, treasurer; H. Howard Bennett, of Montpelier, assistant treasurer, and C. H. Senter, of Montpelier, secretary. These officers were also chosen as the board of directors. The Vermont Power & Lighting Company has the same board of directors.

Ware County (Ga.) Light & Power Company.—At a meeting of the directors of the Ware County Light & Power Company in New York City last week, Stuyvesant Fish was elected president; B. Loomis, Jr., vice-president and C. S. Hammett, superintendent. Mr. Fish is also interested in three other companies in Waycross, the Waycross Gas & Construction Company, the Loomis Utilization Company and the Universal Distillation Company. Extensive improvements are being made by the first-named company calling for the expenditure of over $250,000.

American Telephone & Telegraph Company.—The securities of the American Telephone & Telegraph Company, particularly the stock, are looming up as an extremely popular investment. In the first ten months of the current year the company has added 5000 names to its stockholders' list, and to-day it is claimed that there are over 40000 shareholders. With the exception of the Pennsylvania Railroad and the United States Steel Corporation, the big telephone company is at the present time the most popular corporation in this country.

Edison General Electric Company.—A special meeting of the stockholders of the Edison General Electric Company, which is a subsidiary of the Canadian General Electric Company, has been called for Nov. 16 at the offices of the General Electric Company, 30 Church Street, New York. This call is explained by Henry W. Darling, vice-president of the Edison General Electric Company, as being made necessary because no annual meeting of the Canadian company has been held.

Montreal Street Railway Company.—The report of the Montreal Street Railway Company for its fiscal year, which ended Sept. 30, shows gross earnings of $4,352,551, an increase over the previous year of $477,713. The total net income for the year was $1,475,150 and the surplus, after paying 10 per cent dividends and making a liberal allowance for the maintenance fund, amounted to $200,150. During the past year the company secured an amendment to its charter authorizing the construction and operation of underground railways. Preliminary plans for building some underground lines have been prepared and the work will probably be taken up within the coming year. President L. J. Forget says in his report: "During the past year negotiations were entered into between your directors and the directors of the Montreal Light, Heat & Power Company with a view to bringing about closer relations between the two companies. The scheme submitted did not, however, receive the support of the shareholders of either company to the extent anticipated and has been abandoned, and your directors have been notified by the Montreal Light, Heat & Power Company of their withdrawal from any further negotiations in this connection." The report calls attention to the large extension of the company's business, which necessitates the erection of new shops for the construction and repairing of cars, etc., and says that this work has been commenced. At the annual meeting, which was held on Nov. 2, the Canadian Light & Power Company interests showed that they had a clear majority of the stock of the street railway company. The old board of directors announced that they would not ask re-election and an entirely new board was chosen. The new directors are: E. A. Robert, J. W. McConnell, George G. Foster, K. C.; T. Howard Wilson, W. C. Finley, J. M. Wilson and D. Lorne McGibbon. Mr. Robert was elected president and Mr. McConnell vice-president of the railway company. Mr. Robert is also president of the Canadian Light & Power Company, while the other directors are all directors of the power company. Duncan McDonald was re-elected manager and Patrick Dubee was re-elected secretary. W. G. Ross, former managing director, announced that he was going to take a year's rest in Europe.

Whitney Property Ordered Sold.—The Whitney Power Company's electric developments on the Yadkin River, near Salisbury, N. C., in litigation for several years, and as yet incomplete, will be offered for sale Nov. 30, a final decree having been given at Asheville by Federal Judge J. C. Pritchard in the case of the Bankers' Trust Company against the company. The decree granted provides for the sale of the as yet unfinished plant, together with all of the Whitney properties involved, the Yadkin River Electric Power Company, the Yadkin Land Company, etc. John S. Henderson and Charles W. Smith are receivers. The decree is to satisfy a judgment of $5,406,750 in favor of the Bankers' Trust Company, trustee, under mortgage made in November, 1904. It is further provided that the T. A. Gillespie claim of $344,976 for work done on the plant, dam, etc., shall be settled before the bondholders receive anything, also the cost of litigation, now amounting to $138,000.

Texas Interurban Line.—The plans for the construction of an interurban electric railway between Austin and San Antonio, Tex., with branch lines to Lockhart, Luling and Seguin, are taking definite shape. Vories P. Brown, of San Antonio, one of the promoters of the project, announces that the formal organization of the company will soon be completed and a charter applied for. The company will have a capital stock of $2,000,000. Engineers who have gone over the route of the proposed line between Austin and San Antonio estimate that the cost of its construction will be approximately $1,500,000, exclusive of the power plant. The main line will be eighty-five miles long.

DIVIDENDS.

American Smelters Securities Company, quarterly, 1¼ per cent on preferred B, and 1½ per cent on preferred A, both payable Dec. 1.

Federal Light & Traction Company, quarterly, preferred, 1½ per cent, payable Dec. 1.

Georgia Railway & Electric Company, quarterly, 2 per cent, payable Nov. 19.

Metropolitan West Side Elevated Railroad Company, preferred, quarterly, ¾ per cent, payable Dec. 1.

National Carbon Company, preferred, quarterly, 1¾ per cent, payable Nov. 15.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
American Light & Traction Company:					
Year ended Sept. 30, 1910	.....	.....	$3,575,980	.....	$1,795,101
Year ended Sept. 30, 1909	.....	.....	3,089,190	.....	1,494,665
Bangor Railway & Electric Company:					
September, 1910	$54,806	$19,268	34,538	$13,735	20,803
September, 1909	52,330	18,830	32,500	13,202	19,298
Blackstone Valley Gas & Electric Company:					
September, 1910	89,555	42,518	47,037	.....	16,657
September, 1909	83,997	41,441	42,556	.....	13,105
Brooklyn Rapid Transit Company:					
Quarter ended June 30, 1910	5,572,257	3,587,250	1,985,007	1,572,045	509,262
Quarter ended June 30, 1909	5,284,481	3,794,492	1,489,989	1,312,252	252,874
Cumberland Telephone & Telegraph Company:					
Year 1910	7,060,000	4,100,000	2,960,000	647,000	2,313,000
Year 1909	6,615,368	3,879,440	2,735,928	579,081	2,156,847
Dallas Electric Corporation:					
September, 1910	119,804	75,538	44,266	.....	18,253
September, 1909	107,570	74,512	33,058	.....	7,949
Fort Wayne & Wabash Traction Company:					
September, 1910	136,684	75,496	61,188	45,113	16,075
September, 1909	132,736	71,064	60,704	42,672	18,990
Galveston-Houston Electric Company:					
September, 1910	110,145	63,308	46,837	.....	20,638
September, 1909	100,837	56,363	44,474	.....	21,650
Grand Rapids Railway:					
September, 1910	101,019	51,988	49,031	19,967	29,064
September, 1909	97,626	42,199	54,427	18,958	35,469
Interborough Rapid Transit Company:					
Quarter ended June 30, 1910	7,157,567	3,279,230	4,178,337	2,640,244	1,629,060
Quarter ended June 30, 1909	6,999,041	3,111,079	3,887,912	2600,053	1,540,149
Lake Shore Electric Railway System:					
September, 1910	115,008	54,416	60,592	34,927	25,665
September, 1909	108,207	49,842	58,365	34,804	23,561
Massachusetts Electric Company:					
Quarter ended Sept. 30, 1910	2,741,764	1,434,626	1,307,138	459,512	847,625
Quarter ended Sept. 30, 1909	2,627,877	1,290,899	1,336,978	432,374	904,603
Minneapolis General Electric Company:					
September, 1910	115,902	39,782	76,120	.....	43,769
September, 1909	94,013	38,858	55,626	.....	23,626
Montreal Street Railway Company:					
Year ended Sept. 30, 1910	4,352,551	2,455,301	1,897,250	507,078	1,475,150
Year ended Sept. 30, 1909	4,874,838	2,255,019	1,619,819	445,750	1,230,676
New England Telephone & Telegraph Company:					
Year ended June 30, 1910	12,225,332	8,885,418	3,339,914	120,531	3,522,436
Year ended June 30, 1909	11,031,289	8,306,473	2,724,816	161,035	2,823,786
Norfolk & Portsmouth Traction Company:					
September, 1910	172,065	98,032	74,033	62,859	11,176
September, 1909	158,233	88,373	69,860	63,058	6,804
Seattle Electric Company:					
September, 1910	481,158	274,705	206,453	.....	95,520
September, 1909	568,494	305,341	263,153	.....	156,209
Twin City Rapid Transit Company:					
September, 1910	694,858	323,061	371,791	140,286	231,505
September, 1909	645,197	270,035	375,162	140,251	234,911
Union Railway Gas & Electric Company:					
September, 1910	241,764	120,137	112,627	66,981	45,646
September, 1909	224,313	116,530	107,783	65,070	38,891

General News

Construction News.

CAMP HILL, ALA.—At an election held recently the citizens voted to issue $17,000 in bonds, the proceeds to be used for construction of an electric light plant, plans for which have already been prepared.

MARION, ALA.—The plant and holdings of the Marion Light & Power Company were sold at auction to the Selma Light & Power Company, of Selma, Ala., for $11,000. It is reported that the new owners propose to erect a new power plant on the Cahaba River and build an electric railway between Marion and Selma.

ESCONDIDO, CAL.—The electric light and gas plants of the Escondido Utilities Company have been purchased by a company composed of local men. Charles C. Glass, formerly in charge of the plant, has been appointed president and manager. The property was formerly owned by Seth Hartley.

FORT MASON, CAL.—Sealed bids will be received at the office of the constructing quartermaster Fort Mason, Cal., until Nov. 18 for construction, complete, five single barracks, including plumbing, heating, electric wiring and fixtures, at Fort Winfield Scott, Cal. Plans, specifications and blank forms may be obtained at the above office. Major George McK. Williamston is quartermaster.

LIVE OAK, CAL.—Preparations are being made by the Live Oak & Encinal Electric Light Company to extend its transmission lines north of Live Oak for the purpose of supplying electricity to the ranchers in that district.

LONG BEACH, CAL.—The contract for construction of transformer building at Long Beach for the Southern Caltifornia Edison Company has been awarded to the Richards-Neustadt Company, for $11,550.

LOS ANGELES, CAL.—The stockholders of the Los Angeles Railway Company have voted to increase the capital stock of the company from $5,000,000 to $20,000,000 and to change the name of the company to the Los Angeles Railway Corporation.

LOS ANGELES, CAL.—We are informed that plans have not been completed in connection with the project to construct a large dam across the Colorado River, just across the California line in Arizona and close to the Nevada border, and that work will not begin for some time. Irving E. Bush, Rialto Building, Los Angeles, Cal., is interested in the project.

NEWPORT, CAL.—Bids will be received by L. S. Wilkinson, City Clerk, for a franchise to erect transmission lines in Newport for the distribution of electricity for lamps, heat and motors.

OAKLAND, CAL.—The Southern Pacific Company will soon apply to the City Council for a franchise to equip its Seventh Street line for electrical operation. If a franchise is granted the company will begin work on same at once.

OCEANSIDE, CAL.—Plans are being prepared by the Oceanside Gas & Electric Company to extend its transmission lines to Fallbrook to furnish electricity in that town. The cost of the work is estimated at $4,000. Eugene V. Griffes is secretary and manager.

OROVILLE, CAL.—The Great Western Power Company is reported to be preparing plans for the construction of a large auxiliary dam in the Big Meadows next year, work on which will begin next April. The large dam at Intake in the Feather River Canyon is nearly completed.

RED BLUFF, CAL.—Notice of appropriation of 8000 in. of water in Mill Creek has been filed with the State Engineer by Leon Bly, to be used for irrigation and power purposes.

ROSEVILLE, CAL.—The Pacific Gas & Electric Company has agreed to make improvements to its plant in Roseville.

SAN FRANCISCO, CAL.—Bids will be received by Gen. Charles L. B. Davis, U. S. Engineer Office, 726 Chronicle Building, San Francisco, Cal., until Nov. 28 for electrical machinery on drawbridges across Tidal Canal, Oakland Harbor, Cal.

WILLOWS, CAL.—Arrangements are being made by the Department of the Interior for the erection of a telephone line from Poison Glade, near Paskenta, to the Covelo Ranger station; a line will also be extended from Poison Glade to the ranger station on Black Butte.

DELTA, COL.—The Delta Interurban Railway Company, which proposes to construct an electric railway to connect Delta, Cedaredge and Fairview coal mines, twenty-five miles in length, has secured all of the right-of-way and most of the grading has been done. The power house and repair shops will be located in Delta. Charles G. Montz, 1154 Clarkson Street, Denver, Col., is interested.

EAST HARTFORD, CONN.—The Board of Selectmen has granted the Norwich, Colchester & Hartford Traction Company a franchise to build its proposed railway over certain streets in East Hartford.

MERIDEN, CONN.—The Meriden Electric Light Company is installing a 1000-kw Westinghouse-Parsons turbo-generator set, which will be used for auxiliary purposes.

SUFFIELD, CONN.—The Housatonic Company has submitted a proposition to the village officials offering to replace the present 16-cp carbon lamps, for which the village is now paying $9 per lamp per year, by tungsten lamps of 32 cp for $11 each per year, the company to install the new lamps and fixtures at its own expense.

WATERBURY, CONN.—Surveys have been completed and most of the right-of-way secured for the proposed electric railway to extend from Waterbury to Milldale, a distance of ten miles. Charles H. Preston, Jr., of Waterbury, Conn., is interested in the project.

WILMINGTON, DEL.—The West Chester & Wilmington Electric Railway Company is reported to have secured the right of way and has made arrangements for the construction of the proposed electric railway, seventeen miles in length, to connect West Chester and Wilmington. Lewis Delmas, of Philadelphia, Pa., is president of the company.

WASHINGTON, D. C.—The contract for construction of engine house and power plant at the Freedman's Hospital and Howard University has been awarded to the Boyle-Robertson Construction Company, of Washington, D. C., for $6,683.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the Commissioners of District of Columbia, Washington, D. C., until Nov. 12 for furnishing and installing a complete electric lighting plant for the temporary buildings of the workhouse located at Occoquan, Va. Specifications and form of proposal may be obtained at the office of the chief clerk, Engineering Department, Room 497, District Building. Cuno H. Rudolph, John A. Johnston and William Judson are commissioners.

ATLANTA, GA.—Bids will be received by King & Walker, architects, 90 North Forsyth Street, Atlanta, Ga., until Nov. 12 for construction of Grady Hospital building. The heating, ventilating, plumbing and electrical installations will each be let under separate contracts, for which bids are also requested. Plans and specifications may be obtained from the architects upon deposit of $25, which will be returned upon return of plans and specifications. Joseph Hirsch is president of board of trustees.

AURORA, ILL.—The Fox & Illinois Union Railway Company has been incorporated with a capital stock of $25,000 by John E. Meredith, Joshua Rhodes, Frank Zimmerman, Henry H. Evans and Ralph C. Putnam, all of Aurora. The company proposes to construct and operate a railway from Yorkville to Morris with connecting lines to Dwight and Sandwich.

CHICAGO, ILL.—The Kling Brothers Boiler Works, of Chicago, Ill., is reported to be asking for proposals for the construction and equipment of a machine shop and foundry 160 ft. x 250 ft. and a forge and power house 60 ft. x 80 ft., through Grossman & Proskauer, structural engineers, 84 Dearborn Street, Chicago, Ill.

GRANITE CITY, ILL.—Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Dec. 8 for the construction of the United States post office building, including plumbing, gas piping, heating apparatus and electric conduits and wiring, plans and specifications for which may be obtained from the custodian of site at Granite City, Ill., or at the above office. James Knox Taylor is supervising architect.

ROCKFORD, ILL.—Plans are being considered for the installation of an ornamental lighting system, tungsten lamps to be used, in the downtown district in Rockford, the new lamps to be included in the regular street lighting system. It is proposed to have the merchants install the lamp posts and then turn them over to the city to maintain.

SAVANNA, ILL.—The Independent Telephone Company of Carroll County has taken over the property and holdings of the Central Union Company, of Savanna, in Carroll County, with the exception of the toll line. The exchanges will be consolidated at once and the switchboard enlarged.

SULLIVAN, ILL.—The plant and holdings of the Sullivan Mutual Telephone Company have been sold to H. S. Hankins, of Decatur, Ill., for $20,000. It is understood that a company will be formed at once by parties who own and control the Home Telephone Company, of Decatur. The new company took possession of the property Nov. 1, and will rebuild the entire plant, including the erection of a new exchange and new lines, work on which will begin immediately. It is understood that the proposed improvements will involve an expenditure of from $30,000 to $40,000.

SYCAMORE, ILL.—The County Telephone Company is extending its telephone lines from its Sycamore exchange and erecting several short lines about Clare.

WAUKEGAN, ILL.—The Waukegan, Rockford & Elgin Traction Company has awarded contracts for the construction of the first portion of its proposed railway from Palatine to Wauconda, fifteen miles in length.

ANDERSON, IND.—Arrangements have been made to supply electricity to Pendleton, Middletown and a number of other towns within a radius of ten miles from the local municipal electric light plant. The towns are erecting their own plants and will extend the transmission lines to the Town of Anderson.

GARY, IND.—Application has been made to the City Council by A. F. Knotts and associates for a franchise to supply electricity, gas and water in Gary. Electrical service is now furnished by the United States Steel Corporation.

GREENFIELD, IND.—Plans are under consideration for the consolidation of three or more telephone companies north of Greenfield with the company at Maxwell. Benjamin McClannon, president of the Curry's Chapel Company, is promoting the movement.

INDIANAPOLIS, IND.—The farmers of the Kankakee Valley have appealed to Governor Marshall to prohibit the construction of a dam in the Kankakee River at Momence for power purposes, claiming that the back water will menace their lands.

INDIANAPOLIS, IND.—A new company has been organized recently to take over the plant of the Royse Electric Company, located at 124 Meridian Street, Indianapolis, Ind. The company proposes to make extension and improvements to the plant. The officers are: Robert P. Oblinger, president; Henry E. Rasmussen, vice-president, and Clifford E. Kennedy, secretary.

SHOALS, IND.—The installation of an electric light plant and waterworks system is reported to be under consideration by the City Council.

SOUTH BEND, IND.—The Kalamazoo, Elkhart & South Bend Traction Company has filed amendments to its charter providing for the construction of its railway from South Bend to Kalamazoo, Mich., via Mishwaka, Elkhart, Bristol, Constantine, Nottville, Three Rivers, Parksville, Vicksburg and Austin. A. D. Harris, of South Bend, Ind., is president of the company.

COUNCIL BLUFFS, IA.—The Omaha & Council Bluffs Street Railway Company has applied to the City Council for a franchise to extend its railway in Council Bluffs.

DEFIANCE, IA.—The plant and holdings of the Defiance Telephone Company have been purchased by A. P. Hulsebus, who will take over the property and manage the business.

DES MOINES, IA.—The Des Moines Electric Company is contemplating extensive improvements to its plant in the spring, which will involve an expenditure of about $70,000.

GLIDDEN, IA.—The installation of an electric light system in Glidden is reported to be under consideration.

KEOKUK, IA.—The sale of the property of the Mississippi Valley Telephone Company, which was ordered to be sold by the Federal Court at public auction Oct. 27, was postponed by the order of Judge McPherson until Nov. 26. The property is to be sold under a foreclosure procedure to satisfy a mortgage of $180,000. It is expected that the property will eventually be taken over by the Bell interests.

MANCHESTER, IA.—Negotiations have been closed whereby L. Matthews, president of the State Savings Bank, has acquired the controlling interest of the Manchester Heat, Light & Power Company and will take over the management of the property at once. It is understood that both the steam and electric service will be improved and extended. The establishment of a day service is also under consideration.

MARSHALLTOWN, IA.—Bids will be received by the City of Marshalltown, Ia., until Nov. 28 for installation of machinery and water wheels for development of water power. O. L. Ingledue is Mayor.

MASON CITY, IA.—An independent telephone company is being organized by the farmers of Cerro Gordo and Hancock Counties.

WATERLOO, IA.—Surveys have been completed by the Waterloo, Cedar Falls & Northern Railway Company for its proposed electric railway from Waterloo to Dike, via Cedar Falls, a distance of twenty miles.

GYPSUM, KAN.—The proposition to issue $9,000 in bonds for the purchase of the electric light plant, owned by the Gypsum Light & Power Company, was defeated at an election held recently.

GLASGOW, KY.—The Louisville, Lincoln Farm & Mammoth Cave Traction Company is reported to have completed preliminary arrangements and will soon award contracts for the construction of its proposed electric railway to connect Glasgow and Hodgeville, a distance of forty-seven miles. J. M. Richardson is president.

LOUISVILLE, KY.—The machinery in the new factory building of the Champion Wire & Iron Works, which is now being erected in Louisville, Ky., will be equipped for electric motor drive.

DENHAM SPRINGS, LA.—The Maurepas Telephone Company is extending its telephone line from French Settlement to Denham Springs, a distance of twenty-three miles.

BALTIMORE, MD.—The contract for electric wiring of the new Emerson Tower Building, at Lombard and Eutaw Streets, Baltimore, Md., has been awarded to the Lord Electric Company. Williams & Shock, of Baltimore, Md., engineers, are in charge of the building.

BALTIMORE, MD.—Plans have been prepared for the construction of a large plant at Lexington and Frederick Streets, Baltimore, Md., to replace the old factory of Becker Brothers & Son, recently destroyed by fire. The new factory will be three stories high and will be equipped with machinery for the manufacture of packing boxes, including electric elevators and conveyors. An electric lighting plant will also be installed.

SALISBURY, MD.—The Wicomico Electric & Power Company, recently incorporated with a capital stock of $500,000, proposes to construct and operate an electric railway twenty-five miles in length to connect Salisbury and Nanticoke and intervening towns. The Industrial Engineering Company, Drexel Building, Philadelphia, Pa., has charge of the engineering work. J. D. Price, of Salisbury, is general manager.

BOSTON, MASS.—The contract for the installation of electric wires for the portion of the Suffolk County jail used for male prisoners, bids for which were opened Oct. 31, was awarded to T. T. Kelly & Company, Boston, Mass., for $1,284.

CHARLTON, MASS.—Bids will soon be called for the construction of a power house for the Masonic Home at Overlook. The plant will supply electricity for lamps and motors for the buildings and also steam for heating purposes.

GRAFTON, MASS.—The Massachusetts Board of Gas and Electric Light Commissioners has granted the Uxbridge & Northbridge Electric Company, the Douglas Electric Company, the Millbury Electric Company and the Upton Electric Company permission to consolidate with the Grafton Electric Company. The Grafton company supplies electricity in the towns of Grafton and Sutton and the other companies furnish electrical service in Uxbridge, Northbridge, Douglas, Upton and Millbury. All the companies are owned by the same interests.

PITTSFIELD, MASS.—The new electric plant of the Pittsfield Electric Company erected on Silver Lake has been completed and will soon be ready to put in operation. The equipment of the power house includes a 750-kw turbo-generator set, with two Babcock & Wilcox boilers. The switchboard and all machinery are new.

ROCKLAND, MASS.—Announcement has been made of a reduction in the rates of electricity for both commercial and street lighting by the Electric Light & Power Company, of Abington and Rockland, to go into effect at once. The price for electricity for commercial lighting is to be reduced from 20 cents to 18 cents per kw-hour, with a discount of 10 per cent for prompt payment, and for incandescent street lamps of 32 cp to $15.75 each per year and arc lamps to $69 per lamp per year.

SPRINGFIELD, MASS.—The State Board of Gas and Electric Light Commissioners has refused the petition of the United Electric Light Company to issue 2500 shares of additional capital stock at $160 per share. The commissioners recommended that the directors call another meeting and recommend a higher amount. In its application for permission to increase its capital stock the company states that it proposes to reduce the maximum price of electricity for lamps from 15 cents to 12 cents per kw-hour. Announcement has been made that the new rate will go into effect Dec. 1, 1910. A reduction in the minimum charge has been made from $12 to $8 per year.

WESTFIELD, MASS.—The Westfield Power Company has changed over its entire plant from steam to electrical operation. The change involved the installation of thirty-four electric motors from 1 to 34 hp.

WORCESTER, MASS.—The Worcester Merchants' Association has decided to withdraw the petition presented to the City Council four months ago for installing more lamps on Main Street and to submit a petition to the Council asking for additional street lamps and for ornamental lamp posts to replace the present arc lamp system. The City Council is considering the question of substituting tungsten lamps for the Welsbach lamps now in use.

DETROIT, MICH.—The power plant of the Edmunds & Jones Company, which is being erected in connection with its plant, will be equipped with a 250-kva, Crocker-Wheeler generator direct-connected to an Erie-Ball high-speed engine; the auxiliary plant will be driven by a low-pressure turbine; two 125-hp return tubular boilers, equipped with Jones stokers, will be installed. The company manufactures automobile lamps.

HOUGHTON, MICH.—Plans have been prepared for the construction of new shops for the Copper Range Railroad Company at Houghton. The buildings will be 106 ft. x 16 ft. and 24 ft. x 148 ft. All of the machinery will be equipped for electric motor drive.

AURORA, MINN.—The City Council is making arrangements for the installation of an ornamental street lighting system in Aurora.

BEMIDJI, MINN.—The Red Lake Valley Telephone Company has applied to the City Council for a franchise to install an independent telephone system in Bemidji.

MANKATO, MINN.—The St. Paul-Mankato Electric Railway Company is reported to be securing rights-of-way for its proposed electric railway to connect Mankato, St. Paul and Minneapolis, Minn. J. J. Davy, of Mankato, is engineer.

MINNEAPOLIS, MINN.—Sealed proposals will be received at the office of the city clerk until Nov. 25 for one or two electric-driven centrifugal pumps for use in the water-works department, according to plans and specifications on file in the office of the city engineer.

MINNEAPOLIS, MINN.—The Electric Short Line Railroad Company, which is constructing an electric railway to connect Minneapolis and Medicine Lake, is preparing plans to extend the road to Lake Minnetonka, Watertown and Winsted next year. Frank E. Reed, of Glencoe, is secretary.

PINE RIVER, MINN.—Plans have been prepared by the Power Engineering Company, of Minneapolis, Minn., for the power plant for Weber & Hill, including the construction of concrete dam, bridge, power house, etc. The company will have charge of construction of the plant and furnishing of the equipment.

RUSH CITY, MINN.—It is reported that Herman Anderson is contemplating the installation of an electric light plant on the site of the old Diffenbacher mill.

SPRING VALLEY, MINN.—The Spring Valley Electric Light & Investment Company, it is reported, will soon establish a day service to supply electricity for motors.

HANNIBAL, MO.—Arrangements have practically been completed by the Bluff City Telephone Company for the organization of a company to build a toll line from Hannibal to Wright City, where it will connect with the Kinloch system of St. Louis. The cost of the line is estimated at $100,000.

MEXICO, MO.—The capital stock of the Mexico Power Company is reported to have been increased from $30,000 to $300,000.

BILLINGS, MONT.—The City Council has granted a franchise to John A. Connolly, representing the Billings Traction Company, to construct and operate an electric railway in Billings.

PLAINS, MONT.—The power plant of the Plains Light & Water Company was put into operation Oct. 24. The plant is equipped with a 100-hp Corliss engine, one 80-hp Westinghouse engine, one 50-kw generator, one 30-kw generator and two boilers, 100 hp and 150 hp, respectively.

BLADEN, NEB.—We are informed that contracts will probably be awarded in the near future for the construction of an electric light plant and water-works system in Bladen. Charles F. Sturtevant, of Holdredge, Neb., is consulting engineer.

GRAND ISLAND, NEB.—The Nebraska Telephone Company has awarded the contract for the construction of a new exchange building on Walnut Street.

O'NEILL, NEB.—Desimple & Johnson are reported to have secured the contract for the construction of the local electric light plant. The building will be 110 ft. x 50 ft.

CONCORD, N. H.—The plant and holdings of the Piedmont Carolina Railway Company, operating in Concord, N. C., and in Salisbury, N. C., have been purchased by the Salisbury & Spencer Railway Company for a consideration of $125,000. The consolidation includes two miles of track at Salisbury and one and one-half miles in Concord.

WOODSTOCK, N. H.—The contract for the construction of a concrete dam at North Woodstock, N. H., for the Town of Woodstock has been awarded to the H. P. Cummings Company. The dam will furnish power to operate the municipal electric light plant in Woodstock.

BURLINGTON, N. J.—The City Council has granted the Burlington Electric Light & Power Company a fifty-year franchise in Burlington. The company proposes to erect a large power plant and supply electricity for lamps and motors in Burlington and adjacent towns and also to furnish energy to electric railways.

CHATHAM, N. J.—The Common Council has granted the Morris County Traction Company a thirty-five-year franchise to lay its tracks through Main Street in Chatham.

HARRISON, N. J.—The question of establishing a joint lighting plant to furnish electricity for lighting the three municipalities is reported to be under consideration by the Mayors and Councils of Harrison, Kearny and East Newark.

NEWARK, N. J.—Kaltenback & Stephens, of Brooklyn, N. Y., who are building a large plant at 244-256 Sherman Avenue, Newark, N. J., for the manufacture of silk ribbons, are having plans prepared for a large power house in connection with the plant. The contract for the construction of the main building was awarded to Ritter & Smith, of Allentown, Pa.

PLAINFIELD, N. J.—The Board of Trade has appointed a committee to investigate the question of improving the street-lighting system in the business district of the town. Charles J. Fisk, Mayor, is chairman of the committee.

ENGLE, N. M.—The Secretary of the Interior is reported to have authorized the engineers in charge of the Elephant Butte dam at Engle, N. M., to proceed with the proposed work. Orders were also issued to commence work on living quarters and the installation of a power plant. The cost of the entire work is estimated at about $7,000,000, which will be done directly by the government. About $750,000 is available for preliminary work.

ALBIA, N. Y.—It is reported that bids will soon be awarded for the construction of the power plant on Burden Pond for the Geer Hydroelectric Power Company. The cost of the plant is estimated at about $20,000. Runyan & Carey, of Newark, N. J., are engineers.

BROOKLYN, N. Y.—The contract for furnishing and installing electric equipment in additions to and alterations in the Girls' High School, Borough of Brooklyn, N. Y., has been awarded to T. Frederick Jackson, of New York, N. Y., for $2,042.

FAR ROCKAWAY, N. Y.—The Queens Borough Gas & Electric Company has requested the Public Service Commission, First District, to fix the rates it shall charge for its service. The patrons of the company recently petitioned the commission to bring about a reduction of the prices of $1.30 per 1000 cu. ft. for gas and 15 cents per kw-hour for electricity charged by the company. The company has bound itself to put into effect for one year any rates which the commission may decide are reasonable.

NEW YORK, N. Y.—The Bronx Traction Company has applied to the Board of Estimate and Apportionment for a franchise for an extension of its electric railway on the White Plains Road from Morris Park Avenue to Gun Hill Road. Nelson P. Lewis is chief engineer.

SYRACUSE, N. Y.—The Syracuse Rapid Transit Company is contemplating double-tracking some of its lines in Syracuse, for which a franchise will soon be requested.

UTICA, N. Y.—Application has been made to the City Council by the Utica & Mohawk Valley Railway Company for a franchise to extend its railway from the present terminus in Genesee Street to its line on North Genesee Street in Utica.

WILLIAMSVILLE, N. Y.—George E. De Golio, 984 Ellicott Square, Buffalo, N. Y., recently granted a franchise by the Board of Trustees to supply electricity for lamps and motors in Williamsville, it is said, will secure energy from one of the Niagara Falls plants. The local plant and distributing system will be erected as soon as materials and supplies can be secured.

FRIENDSHIP, N. C.—The Friendship Telephone Company, recently incorporated, is planning to erect a telephone line to connect Greensboro, Friendship, Guilford College and Colfax, N. C. The proposed line will be from thirty to fifty miles in length, bids for which have been received. The company is capitalized at $5,000. Thomas Wakefield is manager.

ROCKINGHAM, N. C.—The sale of the hydroelectric properties of the Rockingham Power Company at Blewitt's Fall, advertised for sale Oct. 5 but postponed at that time because there was no bidder, it is understood, will be sold the last part of this month, and the upset price, it is said, will be reduced to $750,000.

SALISBURY, N. C.—The plant and holdings of the Whitney Company, including extensive development on the Yadkin River, in litigation for several years, and as yet incomplete, together with the property of the Yadkin River Electric Power Company and the Yadkin Land Company, will be sold at auction Nov. 30 by order of Judge J. C. Pritchard, of the Federal Court. The decree is to satisfy a judgment of $5,406,750 in favor of the Bankers' Trust Company, trustee, under a mortgage made in November, 1904. It is further provided that the claim of T. A. Gillespie, for $344,976 for work done on the dam, plant, etc., shall be settled before the bondholders receive anything, also the cost of litigation, amounting to $138,000, to come out of the proceeds of the sale.

HEBRON, N. D.—The Council is reported to have granted a franchise to Messrs. Brown and Weigel for the installation of an electric light plant in Hebron. It is understood that work will begin on construction of the plant in the spring.

ASHTABULA, OHIO.—The Great Lakes Engineering Works, of Detroit, Mich., is reported to be preparing a list of equipment for its shipbuilding plant at Ashtabula, Ohio. A large part of the machinery will be motor-driven. Plans are being prepared for equipment for distribution of power and for lighting. The heavy machinery, including large generators, air compressors, pumping machinery, etc., has already been purchased. It is expected to have the plant ready for operation in the spring.

CINCINNATI, OHIO.—The Cincinnati Traction Company is reported to be contemplating enlarging its Pendleton power house in the East End of Cincinnati. The building will be 40 ft. x 60 ft. and will be equipped with two additional boilers with a rating of 525 hp each. The output of the plant will be increased to 7250 hp. The cost of the improvements is estimated at about $50,000.

CLEVELAND, OHIO.—The Cleveland Electric Illuminating Company has been granted permission to erect a power house on the lake front at East Seventieth Street, to cost about $850,000. The cost of the plant complete is estimated at from $2,000,000 to $3,000,000.

NAPOLEON, OHIO.—The plant and holdings of the Napoleon Home Telephone Company, now in receiver's hands, will be sold at public auction Dec. 12 at the Henry County court house. Ralph P. Brown is receiver.

CARMEN, OKLA.—Plans are being considered for the installation of additional machinery in the municipal electric light plant.

MUSKOGEE, OKLA.—Plans are being considered by the Muskogee Electric Traction Company for the construction of an extension of its Alta Vista line through the brick yards and Crekola to Taft, a distance of nine miles.

HERMISTON, ORE.—The City Council has granted B. A. and G. A. Chisholm a franchise to construct and operate an electric light plant in Hermiston, the same to be installed within six months.

LEBANON, ORE.—The Albany Interurban Railway Company has applied to the City Council for a franchise to construct and operate an electric railway through Lebanon. The proposed railway will extend from Albany, Sweet Home, Lebanon, Brownsville and Holley. P. A. Young is interested in the project.

LINNTON, ORE.—The installation of an electric lighting and power system in Linnton is reported to be under consideration.

PORTLAND, ORE.—The Portland Railway, Light & Power Company is contemplating an extension of the Cazadero line, three and one-half miles in length, work on which will begin at once.

SALEM, ORE.—The Santiam Valley Development Company, of Salem, has applied to the City Council for a franchise to construct and operate an electric railway on certain streets in Salem.

PANAMA.—Sealed proposals will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until Nov. 11 for furnishing motor generator sets and appurtenances, lathe, milling machine, manganese steel castings, paper and plugs. Blanks and general information pertaining to this circular (611-A) may be obtained at the above office, or at the offices of the assistant purchasing agents at 24 State Street, New York, N. Y., and 55 Realty Building, New Orleans, La. Captain F. C. Boggs is general purchasing agent.

CHAMBERSBURG, PA.—Plans are being considered by the Edenville & St. Thomas Rural Telephone Company to construct and operate a telephone system between Chambersburg, St. Thomas and Edenville, thirteen miles in length.

COLUMBIA, PA.—The Columbia Telephone Company has purchased a building on North Third Street, Columbia, which will be taken over April 1, 1911. The company proposes to remodel the building for a telephone exchange. A new switchboard will be installed and the present wires replaced by cables.

DILLSBURG, PA.—The Dillsburg Electric Light, Heat & Power Company, recently incorporated with a capital stock of $15,000, is installing a power plant at Kunkle's mill, on the Yellow Breeches creek, about four miles north of Dillsburg. The company has purchased the local plant, owned by Merle Kunkle, which will be held for use in emergencies; a new street lighting system will be put in and a twenty-four-hour srvice established. It is expected to have the new plant ready for operation by Jan. 1, 1911. J. S. Rapp, Merle Kunkle, Ira T. Heikes and others are interested in the project.

ERIE, PA.—The Northwestern Traction Company, of Erie, has applied to the City Council for a franchise to construct its proposed railway over certain streets in Erie. James Burke is president.

NEW BUENA VISTA, PA.—A new telephone compeny has recently been organized for the purpose of erecting a metallic telephone line from New Baltimore, Somerset County, to a point near Schellsburg.

PHILADELPHIA, PA.—Th new building of the Ontario Dyeing Company has been completed. The building has a total space of 54,000 sq. ft. and will be rented out for manufacturing purposes. Electricity will be the motive power.

PHILADELPHIA, PA.—The Gilpin-Guernsey Company is reported to be preparing estimates for an addition to the exchange of the Bell Telephone Company, located at Preston Street, north of Market. The proposed building will be 51 ft. x 56 ft., four stories high.

SCRANTON, PA.—It is reported that preparations are being made by the Scranton & Binghamton Light Company to supply electricity for lamps to towns and villages along its railway. The company is installing two 100-kw motor-generator sets and expects to be ready to supply electrical service within sixty days in Clark's Green, Clark's Summit, Dalton, Waverly, Factoryville and other towns.

SUNBURY, PA.—Plans are being prepared by the Sunbury & Northumberland Electric Railway Company for extending its railway from Northumberland to Tuc.ahoe Springs, a distance of about two miles.

YORK, PA.—A movement is on foot to construct an electric railway from York, Pa., to Baltimore, Md., for which surveys have already been made. Electricity for operating the proposed railway will be supplied by the York-Haven Water Power Company and the York Railways Company. The Pittsburgh Bonding Company is said to be financing the project.

DARLINGTON, S. C.—The Darlington Light & Water Company is reported to be contemplating improvements to its electric light plant.

SPARTANBURG, S. C.—Preparations are being made by the Electric & Power Manufacturing Company for increasing the output of its local plant by 2500 hp and extension of its transmission lines to Gaffney, a distance of twenty miles, and establishing a substation there. F. H. Knox is vice-president and general manager.

SALEM, S. D.—The roller mill and electric light plant, owned by the Salem Milling, Light & Heating Company and leased to W. R. Huntington, were recently destroyed by fire, causing a loss of about $18,000.

CROSBYTON, TEX.—Preparations are being made by the Crosbyton Telephone Company to extend its telephone line to Floydada at once. The company is rebuilding its system in Crosbyton.

GREENVILLE, TEX.—The Greenville Railway & Light Company has commenced work on the construction of its seven-mile electric railway in Greenville. The power plant and repair shops will be located in Greenville. The company is capitalized at $300,000. A. B. Coryell, of Greenville, Tex., is general manager.

HEMPSTEAD, TEX.—Extensive improvements are being made by the Southwestern Telephone Company to its local system, which will include the installation of cables to replace wires now in use.

PORT ARTHUR, TEX.—Application has been made to the City Council by the Beaumont-Port Arthur Interurban Electric Railway Company for a franchise to build and operate an electric railway in Port Arthur. I. D. Polk is interested in the project.

BURLINGTON, VT.—The Burlington Traction Company is reported to be considering plans for extending its railway through South Bennington, St. George, Shelbourne and Hinesburgh.

CREWE, VA.—The Town of Crewe is advertising for sale bonds to the amount of $25,000, the proceeds to be used for the installation of an electric light plant and water-works system. C. E. Wilson is chairman of finance committee.

HERNDON, VA.—It is reported that the Belmont Trap Rock Company will require motor-driven rock crushers and other equipment in the near future for a quarry which it is developing near Herndon, Va.

NORFOLK, VA.—The Southern Bagging Company, of Norfolk, Va., has erected a large plant for the manufacture of cotton felt mattresses at a cost of about 100,000. The factory is equipped for electric motor drive.

NORFOLK, VA.—The Northside Knitting Mills, recently incorporated with a capital stock of $50,000, has purchased the plant of the Northside Knitting Company and has increased the output of the plant. The mill is equipped for electrical operation.

RICHMOND, VA.—The City Council has granted the Richmond Power Company a franchise to supply electricity in Richmond. The company was recently organized by S. Dabney Crenshaw, Miles M. Martin, Clyde W. Sanderson and others and proposes to erect an electric generating plant at the mouth of the Midlothian Mines and to transmit electricity to Richmond and other nearby cities.

CHEHALIS, WASH.—A petition has been presented to the City Council by the business men asking that an ornamental system of lamps be installed in the business district of the city. It is proposed to place 150 tungsten lamps in the residence district.

CLARKSTON, WASH.—Plans have been completed by the Lewiston-Clarkston Improvement Company for extensions and improvements to its lighting and power system, which will involve an expenditure of about $100,000. It is proposed to increase the output of the steam auxiliary plant from 1000 hp to 3000 hp and to reconstruct the local system. Surveys are nearly completed for a larger water power plant on the Grande Ronde River, work on which will begin as soon as plans have been completed.

NORTH YAKIMA, WASH.—Plans are being considered for the installation of an ornamental electric lighting system on Naches Avenue, bids for which will soon be called.

PORT TOWNSEND, WASH.—It is reported that a company has been organized by Charles C. Gentry, Walter Stange and Arpad Tokay for the purpose of constructing Boyes monorail railways to Bellingham, Mount Vernon, Irondale and Port Angeles. The company is capitalized at $7,000,000.

SEATTLE, WASH.—J. Frederic Thorne and associates have petitioned the County Commissioners for a franchise to construct and operate an electric railway from Kirkland to Tolt, a distance of forty miles.

SEATTLE, WASH.—The Puget Sound, Chelan & Spokane Railway Company has awarded the contract for the construction of its proposed electric railway to connect Tacoma, Seattle and Spokane to the W. K. Palmer Company, of Kansas City, Mo. W. W. Shenk, of Seattle, Wash., is president of the company.

TACOMA, WASH.—The Seattle-Tacoma Short Line Railway Company is reported to have awarded the contract for the construction of an extension of its railway from Youngstown to Lake Burien, a distance of eight miles, to Homer Crosby.

WHITE BLUFFS, WASH.—The Pacific Power & Light Company, of North Yakima, is reported to be contemplating extending its transmission lines to White Bluffs to supply the farmers in this district with electricity for lamps and motors. It is proposed to tap the line extending from its power plant at Priest Rapids to Hanford and erect a substation in this town. It is understood that a street lighting system will be installed as soon as line is completed.

FAIRMONT, W. VA.—It is reported that arrangements are being made by the Fairmont & Clarksburg Traction Company for the construction of an extension of its railway from Clarksburg to Northview. S. B. Miller, of Fairview, is chief engineer.

GRAHAM, W. VA.—The Graham Light & Power Company has been granted a franchise by the Town Council to construct and operate an electric light plant and water works system in Graham. The franchise also carries the privilege of building a street car line.

HURRICANE, W. VA.—It is reported that the Clinchfield Coal Corporation, of Spartanburg, S. C., and 24 Broad Street, New York, is preparing plans for the construction of a power plant and substation at Hurricane, also three other substations. The contract for electrical equipment has been awarded to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., and includes two 1000-kw, 6600-volt turbo-generators and ten 300-kw, 250-volt synchronous motor generator sets, to be ready for operation by April 1. Contracts for boilers and other auxiliaries will be awarded soon. Ford, Bacon & Davis, 115 Broadway, New York, N. Y., are engineers.

KEYSER, W. VA.—Plans are being prepared by the Baltimore & Ohio Railroad Company for additions to its car shops at Keyser, W. Va., to provide facilities for repairing steel freight and passenger cars. The first of the new buildings will be 50 ft. x 300 ft., which will be equipped for electrical operation throughout.

MIDDLEBOURNE, W. VA.—T. Moore Jackson, of Clarksburg, W. Va., is reported to have secured the contract for construction of the Middle Island Railroad Company's proposed electric railway to extend from Sisterville and Middlebourne, a distance of eleven miles. The proposed railway will connect Sisterville and Clarksburg and intervening towns, a distance of sixty miles. John F. Shore, of Middlebourne, W. Va., is secretary.

ASKEATON, WIS.—The Maple Valley Telephone Company, recently organized, is planning to erect a telephone line to Wrightstown, a distance of six miles, where connection will be made with the lines of the Fox River Valley Telephone Company. John L. Sullivan is general manager.

CAMPBELLSPORT, WIS.—The Campbellsport Electric Light & Power Company is reported to be contemplating the construction of a new power plant, which will be equipped with a gas-producer plant, gas engines and two new electric generators. Richard Thomas, of Milwaukee, Wis., is reported to have disposed of his interest in the property.

EAU CLAIRE, WIS.—The Chippewa Valley Railway, Light & Power Company, of Eau Claire, Wis., expects to purchase a 300-kw rotary converter for 600-volt direct current with transformers for street railway service. George B. Wheeler, of Eau Claire, Wis., is general manager.

JANESVILLE, WIS.—Plans have been prepared by the Commercial Club of Janesville for the installation of an ornamental lighting system on the principal business streets of the city. It is proposed to use tungsten lamps. Under the present plan it is proposed to have the property owners pay for the lamp posts and the merchants to maintain the system. The Janesville Electric Company will supply electricity for the lamps.

MILLTOWN, WIS.—The Milltown Mutual Telephone Company is reported to be contemplating making extensions to its lines.

MILWAUKEE, WIS.—The Milwaukee Railway & Light Company expects to begin work on the construction of its proposed electric railway to connect Whitewater, Elkhorn and Lake Geneva, twenty-one miles in length, in March, 1911. The company also proposes to furnish electricity for lamps. The main offices of the company are located at 711 Majestic Building, Milwaukee, Wis. H. B. Kamschutte, of Milwaukee, Wis., president and chief engineer.

NEENAH, WIS.—Work has commenced on the construction of a new factory building for the Hardwood Products Company, of Neenah, Wis., 90 ft. x 190 ft., three stories high, a boiler house, two dry kilns and warehouse. Plans for equipment have not yet been decided upon, but the company is now considering the question of equipping the plant for electric motor drive.

PLUM CITY, WIS.—Extensive improvements have been made to the local system of the Pepin Telephone Company, including the installation of a new switchboard and replacing the old system with a new metallic system.

STOUGHTON, WIS.—The City Council is considering the question of installing an ornamental street lighting system.

WAUSAU, WIS.—Preparations are being made by the Wausau Telephone Company for the construction of a new telephone exchange building, bids for which will be received until Nov. 22. Van Ryn & DeGelleke, Milwaukee, Wis., are architects.

CHEYENNE, WYO.—Bids will be received at the office of the constructing quartermaster, Cheyenne, Wyo., until Nov. 14 for the completion of certain items of construction in administration building, rear annex and ward wings 3 and 4, new post hospital at Fort D. A. Russell, Wyo.; also for the installation of plumbing fixtures, heating fixtures and electric light fixtures in said ward wings Nos. 3 and 4 of new post hospital. Plans, specifications and general instructions are on file in the above office and also at the offices of the chief quartermaster, Department of Missouri, Omaha, Neb.; Department of Colorado, Denver, Col., and the secretary of the Builders' Exchange, St. Paul, Minn. Captain F. S. Armstrong is constructing quartermaster.

PORT ARTHUR, ONT., CAN.—A proposition is being considered by the merchants of Port Arthur, submitted by the Industrial Bureau, to establish a telephone service to be extended from Port Arthur to towns within a radius of 400 miles on the west and 600 miles on the east and a trunk line leading to Duluth, to connect ultimately with Toronto and Winnipeg.

SWIFT CURRENT, SASK., CAN.—Contracts have been awarded for power plant and settling basin as follows: For power house and settling basin to Laidlaw & McDonald, of Fort William, Ont., at $15,921 and $4,499, respectively; and to Chapman & Walker, of Toronto, Ont., for pumping machinery, $8,650; electrical machinery, $16,650 and producer gas plants at $25,000.

New Industrial Companies.

THE AMERICAN PISTON COMPANY, of Indianapolis, Ind., has been incorporated with a capital stock of $30,000 for the purpose of manufacturing a new patented piston, which it is claimed will revolutionize the manufacture of engines. The officers of the company are: F. O. Filton, president; A. H. Schlaegel, vice-president, and V. D. Morrison, secretary and treasurer.

THE BURKE ELECTRIC WORKS COMPANY, of New Orleans, La., has been incorporated with a capital stock of $15,000. The officers of the company are: Otto T. Maler, president; Thomas J. Burke, vice-president, and James Brady, secretary and treasurer.

THE GYROSCOPE ELECTRIC COMPANY, of Bay City, Mich., has been organized with a capital stock of $50,000 to conduct a general electrical manufacturing and constructing business. The directors are: E. V. Ingersoll, James C. McCabe, W. J. Kickbush, Charles Englehart and Edward Lankenaw, all of Bay City, Mich. George M. McBride is general manager.

THE INTERNATIONAL ELECTRIC CONSTRUCTION COMPANY, of St. Louis, Mo., has been incorporated with a capital stock of $3,000 by Roland H. Robinson, Arnold S. Doxsee, Leigh A. Doxsee and others. The company proposes to do a general construction business.

THE INTERNATIONAL MOVABLE ELECTRICAL DISPLAY COMPANY, of Baltimore, Md., has filed articles of incorporation with a capital stock of $50,000. The incorporators are: Charles J. F. Steiner, 101 North Eighth Street, Baltimore, Md., and others.

THE NATIONAL INSULATOR COMPANY, of Wellsburg, W. Va., is being organized by W. F. Baird, J. E. Inman, C. F. Louthaime and others, of Pittsburgh, Pa. The company will be capitalized at $600,000 and proposes to take over the plant of the Riverside Glass Company and equip same for manufacturing glass insulators.

THE NATIONAL TELEPHONE SUPPLY COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $20,000 by William H. Marlatt, F. H. Pelton, M. Jenkins, J. B. Bolton and M. B. Campbell.

THE OKLAHOMA LIGHTNING ARRESTER & ELECTRIC COMPANY, of Tulsa, Okla., has been incorporated by George A. Stewart, of Tulsa, Okla.; A. B. Shawver, of Grimes, Ia., and others. The company is capitalized at $10,000 and proposes to manufacture a lightning arrester.

THE STANDARD AUTOMATIC MACHINE COMPANY, of New York, N. Y., has been chartered by L. Sachs, B. H. Levy and C. J. White, of New York, N. Y. The company is capitalized at $50,000 and proposes to manufacture and deal in machinery.

THE STANDARD ENGINEERING & CONSTRUCTION COMPANY, of Camden, N. Y., has been incorporated with a capital stock of $100,000 by W. S. Everett, T. S. Bradley, H. P. Gallagher and C. R. Stevenson, of Camden, N. J. The company proposes to do a general engineering and contracting business.

THE UNITED ELECTRIC APPARATUS COMPANY, of Boston, Mass., has been incorporated with a capital stock of $75,000 to do a general electrical business. L. N. Downs, of New York, N. Y., is president and H. A. Rambonnet, of Boston, Mass., is treasurer.

THE WILLIAM CORLISS VALVE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000 to manufacture machinery, valves, etc., by W. Corliss, I. G. Ladd, of Providence, R. I., and E. W. Corliss, of New York, N. Y.

New Incorporations.

WILMINGTON, DEL.—The Scranton & Binghamton Railway Company has filed articles of incorporation with a capital stock of $6,000,000. The incorporators are: Warren N. Akers, Millard C. Taylor and William J. Maloney, all of Wilmington, Del.

ELBERTON, GA.—The Hill Power Company has been incorporated with a capital stock of $50,000 by W. O. Jones, S. L. Hill, L. H. Hill and others.

SPRINGFIELD, ILL.—The Springfield & Central Illinois Traction Company has been granted a charter with a capital stock of $20,000 to construct and operate a railway from Springfield, Ill., to Nashville, Ill. The incorporators are: Isaac E. Smith, George W. White and Noble E. McMillan, all of Springfield, Ill.

OSKALOOSA, IA.—Articles of incorporation have been filed with the Secretary of State for the Iowa Traction Company with a capital stock of $2,000,000 by G. E. Woodhouse, of Oskaloosa, Ia.; J. C. Mabry, of Albia, Ia., and I. T. Hunter, of Newark, N. J. The company proposes to construct and operate an electric railway to connect Oskaloosa and Tama, sixty-five miles in length.

PORTLAND, MAINE.—The Municipal Light & Power Company has been chartered with a capital stock of $250,000 for the purpose of generating and distributing electricity and gas for light, heat, etc. E. E. Witherby, of New York, N. Y., is president, and F. D. Marshall, of Portland, Maine, treasurer.

GORDONVILLE, MO.—The Gordonville Telephone Company has been incorporated with a capital stock of $1,000 by Lewis C. Hitt, A. S. Poe, M. H. Lupke and others.

TRENTON, N. J.—The Trenton-Mercer County Traction Company has been chartered with a capital stock of $10,000 by George W. McPherson, Rankin Johnson and Oscar T. Crosby. Peter E. Hurley is local agent.

PHILIPSBURG, PA.—Articles of incorporation have been filed for the Consolidated Traction Company to construct and operate an electric railway from Philipsburg to Curwensville. The company is capitalized at $100,000. W. Ellis Shomo is interested in the project.

NASHVILLE, TENN.—Articles of incorporation have been filed for the Houston County Telephone & Telegraph Company with a capital stock of $5,000 by G. P. Atchison, W. R. Boone, J. F. Sullivan, G. A. Atterwhite and others.

ROCKPORT, TEX.—The Union Terminal Railway Company has applied for a charter to construct a railway, to be operated by steam or electricity, to connect Rockport, Aransas Pass, Navy City, Port San Antonio and to and over the Sheel Bank and Harbor Island, twenty-five miles in length. The company is capitalized at $25,000 and the officers are: Charles F. Hoff, of Rockport, president; W. H. Verner, vice-president; W. D. Newberry, secretary, and Thomas E. Mathis, treasurer.

WOODSTOCK, VA.—The Manufacturers' Light & Power Company has been incorporated with a capital stock of $25,000. The incorporators are: R. S. Funk, president; C. L. Kneisley, secretary; S. M. Zea, B. R. White and C. D. Brown, all of Strasburg, Va.

ALTA, WASH.—The Alta & Jordan Valley Railroad Company has been incorporated with a capital stock of $200,000 to construct and operate an electric or steam railway from Sandy to Alta, a distance of sixteen miles. The incorporators are: D. J. and M. A. Williams, William F. Williams and B. F. and E. W. Cummings.

Personal.

MR. J. G. WHITE has been elected a director of the Merchants' Association of New York to fill the vacancy caused by the death of Mr. Walter C. Kerr.

MR. C. C. WEBSTER has resigned as chief engineer of the Schenectady (N. Y.) pumping station to become proprietor and general manager of the La Veta (Col.) Light, Heat & Power Company.

MR. KENNETH SEAVER has been appointed chief engineer of the Harbison-Walker Refractories Company, Pittsburgh, Pa., which includes among its products lining material for electric furnaces.

MR. EDWIN D. SMITH, formerly superintendent of power station for the United Railways Company of St. Louis, has been appointed manager of the Municipal Electric Light & Water Plant, Columbia, Mo.

MR. PETER SPANG KLEES, sales manager of the Franklin Electric Manufacturing Company, was married Oct. 19 at Hartford, Conn., to Miss Daisy Elizabeth Miner, daughter of Mrs. Caroline A. Miner, of that city.

MR. JUDSON H. BOUGHTON, secretary and treasurer of the National Light & Improvement Company, St. Louis, is delivering at the University of Missouri a course of lectures on "Public Utility Engineering and Management."

MR. J. E. NOEGGERATH, well known from his work with the unipolar direct-current generator, has severed his connection with the General Electric Company and opened an office as consulting electrical engineer in New York City.

MR. A. T. RUTTENCUTTER, who has spent the past three months visiting places of electrical interest in the United States, has returned to Brazil to continue his connection with the Rio de Janeiro Tramway, Light & Power Company, with which he has been associated for the past four years.

MR. T. C. RINGGOLD has accepted the position of general sales manager of the Central Electric Company, of Chicago. Mr. Ringgold's more recent connections have been as sales manager of the Robertson Electric Company, then general manager of the Cataract Electric Company, both of Buffalo, and last in a special capacity with the General Electric Company, of Schenectady, N. Y.

C. M. SEELEY, of Los Angeles, for twenty-three years with the Pacific Telephone & Telegraph Company in Southern California, has resigned his position as division commercial superintendent and is succeeded by J. W. Gilkyson, of Los Angeles, formerly division plant superintendent. Mr. Seeley has acquired an interest in the Fairchild-Gilmore-Wilton Company, of Los Angeles, and will take up his duties with that firm.

MR. C. E. WHITE, who for the past two years has been manager of the People's Electric & Ice Company, Montgomery, Ala., has been appointed manager of the Montgomery Light & Water Power Company, to succeed Mr. Robert J. Chalmers, who resigned after eleven years of service with the company. Mr. White has spent most of his business life with electric and gas companies, having entered the business in Philadelphia. He was at one time acting engineer, with the title of ensign, in the United States Navy.

MR. JULIUS ANDRAE, of Milwaukee, celebrated the fiftieth anniversary of the founding of the large electrical-supply business now conducted by his sons with a reception to his friends and local electrical men, Oct. 22. During the day an electrical luncheon was served, prepared with the aid of electric cooking devices, and in the evening the whole party sat down to a banquet. The electrical supply business of 1860 had to do chiefly with door-bell supplies, being the outgrowth of a mechanical door-bell ringer devised by Mr. Andrae.

MR. CLARENCE H. MACKAY, president of the Postal Telegraph-Cable Company and chairman of the Executive Committee of the Chicago Grand Opera Company, played the part of Santa Claus in Chicago on Nov. 3 by taking about ninety heads of departments and office employees in the Chicago office of the Postal company to Verdi's opera of "Aida." About the same number of operators were to be taken on a succeeding night and a like number of messengers to a third performance, according to Mr. Mackay's plans, as disclosed on the date mentioned. The Postal employees in Chicago appreciated their president's generosity greatly.

MR. W. H. GERRISH has been appointed smoke inspector of the Massachusetts Gas & Electric Light Commission, following a competitive examination for the post under the civil service requirements. The Legislature of 1910 passed a law placing the enforcement of smoke regulation in the hands of the board, and this has necessitated the creation of a separate division in the executive offices of the commission. Mr. Gerrish is a graduate of the Massachusetts Institute of Technology, class of 1888, in the course in mechanical engineering, and his experience has been largely along the lines of mill engineering and power production problems. He served as engineer and superintendent of the Lancaster (Mass.) Slate Company from 1888 to 1894; was mechanical engineer of the Massachusetts Cotton Mills, of Lowell, in 1894-96, and was engineer of tests with the Schlict Combustion Company, of Boston, for a short time in 1897. Mr. Gerrish then became attached to the United States Ordnance Department at Large, and was occupied for about two years in the design and improvement of carriages for disappearing guns and motors. He then became mechanical engineer of the Barber Flax Spinning Company, of Paterson, N. J., and after a term of service as technical adviser to the president became master mechanic and later general mechanical superintendent of the Dolphin Jute Mills, of Paterson, his engagement with this company covering the period from 1900 to 1907. From 1907 to 1909 Mr. Gerrish was general superintendent of the Commercial Twine Company, New York, and later became superintendent of the soft-fiber department of the Columbian Rope Company, of Auburn, N. Y. Prior to his joining the staff of the Gas and Electric Commission, Mr. Gerrish was engaged in designing engineering with the firm of Lockwood, Greene & Company, Boston. He is a member of the American Society of Mechanical Engineers.

Obituary.

MR. STILLMAN WILLIAMS ROBINSON, emeritus professor of mechanical engineering at Ohio State University, died Oct. 31. Professor Robinson had served the university since 1878, having acted as professor of mechanical engineering from 1881 to 1895, when he resigned to give more attention to his extensive professional engineering work. Professor Robinson was perhaps best known as an inventor of a very high order, applying his fine mathematical and scientific knowledge to the best adaptations in the apparatus he designed. The Society for the Promotion of Engineering Education will mourn the loss of Professor Robinson as its founder, for in 1890 he organized this association, which later acquired its present name.

MAJ.-GEN. JAMES JOURDAN, for many years a commanding figure in corporation, political and military affairs, died in Brooklyn on Nov. 1, in the eightieth year of his age. General Jourdan was a director of the New York & New Jersey Telephone Company, the Interborough Rapid Transit Company, the Rapid Transit Subway Construction Company, the Subway Realty Company, the Interborough-Metropolitan Company, the New York & Long Island Railroad Company, the New York & Queens County Railway Company, the Long Island Electric Railway Company, the New York & Long Island Traction Company and several gas lighting, realty and banking companies.

SIR CLIFTON ROBINSON, well known among the pioneers in electric railway work in America, England and the Continent, having been especially identified with the first railways in Los Angeles, Cal., and London, England, died suddenly of heart disease in New York City on Nov. 6. He was born in Birkhead, England, on Jan. 1, 1848. He became a member of the staff of George Francis Train, who built the first street railway in Europe at Birkeland in 1860, when Sir Clifton was a small boy. In 1866 he came to America as one of Train's employees in street railway construction. He later returned to London and in 1871 undertook the engineering work of street car line construction in Cork. Four years later he became general manager of the Bristol tramways and then became manager of the tramways of Edinburgh. In 1884 he started building the Highgate Cable Tramways, the first of their type in England. Returning to America, he put through a system of traction for Los Angeles, then designed and constructed the London United Electric Tramways System and in 1895 constructed the first electric tramway at Bristol. As managing director and engineer of the Imperial Tramways Company he constructed and reorganized the Dublin Southern District Electric Tramways in 1896 and the Middlesbrough, Stockton and Thornaby Electric Tramways in 1898. In 1902 he took part in the construction of the great tube railway system of London and in 1906 designed and put into operation a successful system of through booking between tramways and railways in London. In 1889 he was engaged by the American Street Railway Association to report on the general situation with regard to street railways in the United States. His report was presented at the association's convention at Pittsburgh in 1891. In the latter year he advised the City of Bristol to change its cable lines to electric lines and himself took charge of the work. In 1898 he converted the street car lines of Stockton-on-Tees for the use of electricity. He became managing director of the United Tramways Company of London in 1904 and succeeded in converting it into an electric system against considerable opposition. In 1905 he was knighted by King Edward for his services in connection with the underground

Sir Clifton Robinson.

and other transit lines in London. He was the author of numerous papers on street railway subjects. He is survived by a widow and one son. Sir Clifton was taken suddenly ill in a street car and was carried to a drug store, where he died. Lady Robinson was with him when the end came.

Trade Publications.

RAILWAY APPARATUS.—Auxiliary contactor equipments are briefly described in Folder 4186 just issued by the Westinghouse Electric & Manufacturing Company.

DECORATIVE LIGHTING OUTFITS.—The General Electric Company has just issued a folder, No. B. 3011, describing its decorative lighting outfits for Christmas trees.

MOTOR STARTERS AND CONTROLLERS.—The Cutler-Hammer Manufacturing Company, of Milwaukee, has issued recently five new bulletins relating to alternating-current apparatus. They refer to the company's single-phase motor starter, the face-plate, drum-type and multiple-switch type polyphase motor starter and the radial-arm crane controller.

ELECTRIC RAILWAY CONTROLLERS.—A very interesting, well-illustrated booklet has just been issued by the Westinghouse Electric & Manufacturing Company on the subject of unit switch control. The circular, numbered 1189, explains the plan of operation of this type of control, shows complete wiring and piping diagrams and discusses the details of the apparatus.

METALIZED FILAMENT INCANDESCENT LAMP.—In Bulletin No. 4780, just issued by the General Electric Company, is illustrated and described the Gem lamp, which has a higher economy and greater illuminating power than the carbon, but is, of course, less efficient than either the tantalum or tungsten. This bulletin supersedes all previous bulletins on this subject.

BUILDING LIGHTING.—In an attractive publication recently issued by the General Electric Company on the subject of "Building Lighting" many illustrations of both exteriors and interiors of buildings lighted by tungsten and tantalum lamps are shown. In addition to these illustrations there are data relative to the subject and illustrations of the complete lines of both types of lamps. The number of the bulletin is 4777.

SERIES TUNGSTEN LAMPS FOR STREET LIGHTING.—In Bulletin No. 4781, recently issued, the General Electric Company illustrates the series tungsten lamp and offers a good many data on the advantages possessed by this lamp over the other incandescent lamps used for this purpose. The bulletin illustrates also various styles of fixtures used in connection with street illumination and contains other matter of service to all interested in this subject.

HYDRAULIC TURBINES.—Bulletin No. 101 of S. Morgan Smith Company, York, Pa., is a handsome pamphlet of fifty-two pages giving illustrations and data of Smith hydraulic turbines. Among the engravings are excellent views of a number of large hydroelectric equipments, some of which have not yet been described in the technical press. Of particular interest to electrical engineers are views and data of hydroelectric equipments for the Connecticut River Power Company, Chattanooga & Tennessee River Power Company, Roosevelt Salt River plant, Great Falls (Mont.) Water-Power Company, Winnipeg Electric Railway Company and La Crosse Water-Power Company. Another bulletin recently issued by the same company illustrates and describes head-gate hoists.

ELECTRIC HEATING DEVICES.—The Cutler-Hammer Manufacturing Company, of Milwaukee, has published a thirty-two page booklet in which its new line of electric-heating devices is fully described and illustrated. A section of the pamphlet is devoted to each of the separate lines—electric irons, disk stoves, toilet devices, portable water heaters, instantaneous water heaters, electric radiators and culinary devices. In the back of the book a folded data sheet is inserted. This gives prices, weights, dimensions, energy consumption, time required to heat, cost of operation, etc. The complete information, aside from the general description, is thus presented in a nutshell. The book in itself is a handsome one. The illustrations are very well executed and printed in a rich brown on India tint paper. The text is printed in olive-green ink, making a pleasing combination. A maroon cover, with silver embossed lettering, adds to the effect.

BUSINESS NOTES.

THE AMERICAN TELEGRAPHONE COMPANY has moved its factory from Wheeling, W. Va., to Springfield, Mass.

THE VOHR SALES COMPANY, of Chicago, has been incorporated to be the distributor in Chicago of the Vohr ozonizers, made by the Standard Electro-Utilities Company of the same city.

THE CHICAGO FUSE WIRE & MANUFACTURING COMPANY has moved to its new six-story building, 1014 to 1022 West Congress Street, Chicago. With increased facilities, the company is equipped better than ever to give its customers prompt and satisfactory service.

INCREASED MANUFACTURING FACILITIES FOR NUTTALL COMPANY.—As a result of expansion in its business, the R. D. Nuttall Company has recently made a considerable increase in its factory facilities. A new wing has been added to its building at the corner of Garrison and Fayette Ways, Pittsburgh, Pa. It is expected that the new structure, by greatly adding to the available floor space, will relieve some of the congestion that has existed in the plant. The Nuttall company manufactures gears and pinions, trolleys, flexible couplings, etc.

THE MOORE LIGHT COMPANY, of Newark, N. J., has opened a demonstration and sales room in New York at 500 Fifth Avenue. The Moore yellow and daylight-white vacuum tube lamps are to be pushed vigorously from this new office. The regular business of installing long yellow light tubes for general illumination is to be followed up actively, and some especially energetic work is to be done with a new small portable unit called the "Daylight-Window." This window has been designed especially for use in department stores, haberdashery shops and all places where colors are dealt with. It is claimed to give an absolute reproduction of daylight, which shows colors accurately in their true values, and forms a complete and convenient matching cabinet.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED NOV. 1, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

974,109. CIRCUIT INTERRUPTER; C. B. Auel and J. E. Spurrier, Wilkinsburg, Pa. App. filed Sept. 4, 1906. A mechanical circuit breaker with a fuse in series which is first shunted and then the circuit breaker operated when the fuse is broken.

974,110. TELEPHONE APPARATUS; G. Babcock, Rochester, N. Y. App. filed May 8, 1908. Small-sized transmitter including a casing and an electrode, the latter consisting of two concave plates, one a disk and the other a ring, together with a convex member carrying a diaphragm, with carbon between the members.

974,112. CIRCUIT-CONTROLLING MECHANISM; F. Bechoff, Schenectady, N. Y. App. filed Dec. 16, 1908. Electric switches which are interlocked with a movable indicator actuated by one of them and a member actuated by the other movable into the path of the indicator so as to prevent simultaneous closing of the switches.

974,152. ELECTRIC MOTOR CONTROL; H. D. James, Pittsburgh, Pa. App. filed March 4, 1907. To avoid flashing in shunt or compound motors for elevators by inserting resistance which is automatically cut out as the speed is accelerated by means of electrically governed switches operating in sequence with automatic means for opening them in the same sequence.

974,157. THERMO-ELECTROSTAT; Roscoe William King, Las Animas, Col. App. filed June 11, 1909. Contains a fluid responding to heat and the conduit containing a plunger dipping in the fluid, which plunger carries a conducting cross-head carrying contacts for a circuit-breaker.

974,161. HEATING SYSTEM; H. Lemp, Lynn, Mass. App. filed May 10, 1910. For steam boilers in which a current of electricity passing through the water generates the steam. A body of mercury is in the path of the current, into which the water feed pipe dips, preventing corrosion of the electrodes.

974,167. TRANSFORMER; M. Mayer, Pankow, Germany. App. filed May 3, 1909. Oblong insulating block, a plurality of which is placed between adjacent coils with their ends extending beyond the edges of the coils. The blocks are held in place by rods fastened to them.

974,169. TRANSMITTING APPARATUS; F. W. Midgley, Jersey City, N. J. App. filed Feb. 1, 1906. An aerial grounded at one end with a conductor connecting the top non-inductively to earth and a condenser connected in the conductor near the earth end.

974,171. RECTIFYING ELECTRIC CURRENTS; John J. Montgomery, Santa Clara, Cal. App. filed Aug. 28, 1909. For rectifying alternating currents by a rotating commutator or pole changer, one element of which has a step-by-step rotation corresponding to fluctuations in the duration of the waves.

974,177. INSULATOR FOR HIGH-TENSION TRANSMISSION SYSTEMS; J. E. Noeggerath, Schenectady, N. Y. App. filed Feb. 9, 1910. Petticoat insulators with yieldable slugs between the spring bolt and shoulder on the insulator, the slugs preferably being in the nature of ball bearings.

974,191. WIRELESS APPARATUS; F. G. Sargent, Westford, Mass. App. filed April 3, 1909. For receiving and transmitting spherical waves by using a sphere at the top of the antenna.

974,192. ELECTRIC METER; G. A. Sawin, Lynn, Mass. App. filed Sep. 31, 1906. For reducing wear on jeweled bearings and eliminating creeping by providing a winding in series with the coils which lifts the shaft when the current ceases, thus stopping the motor.

974,207. INSULATOR SUPPORT; W. R. Thompson, Chicago, Ill. App. filed May 10, 1910. Petticoat insulator support, including diverging bars connected at one end and each connected to the pole between its ends.

974,220. ELECTRIC INSOLE; Charles W. West, Denver, Col. App. filed March 23, 1908. Details.

974,224. ELECTRIC BRAKING; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Oct. 9, 1909. Operates an alternating commutator

motor as a generator for dynamic braking by connecting the armature to the source, separately exciting the field and varying the connections between the armature and source and the field current to vary the braking effect.

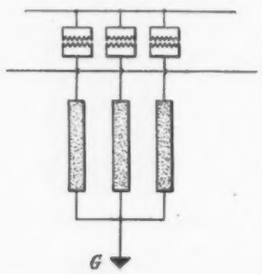
974,223. LIGHTNING ARRESTER; A. J. Wurts, Pittsburgh, Pa. App. filed Sept. 5, 1905. Glass strips coated with graphite, the passage of the current destroying it and fracturing the glass.

974,227. ELECTRODE FOR ARC LAMPS; E. R. Berry and E. J. Guay, Lynn, Mass. App. filed July 9, 1909. Composed of a tube of aluminum with a filling of titanium carbid.

974,232. ELECTRICAL SAD-IRON; W. A. Braun, Fort Wayne, Ind. App. filed Feb. 23, 1910. A hollow base contains the heater and a thermal expanding member controls a lever which breaks the current when the iron is sufficiently heated.

974,238. MOTOR CONTROL; A. M. Coyle, New York, N. Y. App. filed Jan. 30, 1908. For hoisting and lowering theater curtains by means of an electric motor, controlling devices therefor, a brake magnet, a trip magnet and friction disks between the motors and the hoisting drum.

974,275. ILLUMINATED SIGN; W. H. Ingle, Tacoma, Wash. App. filed Aug. 17, 1909. Lamps are arranged in each letter block so that any letter can be formed by the illumination of certain lamps thereon and a rotating controlling cylinder carrying plugs operates a lever to control the contacts.



974,223.—Wurts Lightning Arrester.

974,389. — Electrode for Electric Arc Lamp.

974,279. AUTOMATIC TELEGRAPHY; G. T. Kanzer-Chegodard, Kamenka, Russia. App. filed March 31, 1903. Conducting surfaces on a strip of paper close the circuit to send signals.

974,296. ELECTRIC GLOW LAMP; H. Remane, Berlin, and Emil Gottschalk, Charlottenburg, and Eugen Hurwitz, Berlin, Germany. App. filed July 18, 1907. Tungsten filament lamp with a support having a core of one metal and coating with different metal, one of the metals forming an alloy with the tungsten.

974,328. FLUID PRESSURE CONTROLLED SWITCHING DEVICE; C. Aalborg, Wilkinsburg, Pa. App. filed Dec. 6, 1907. A fluid pressure operated switch for controlling the generation of steam for heating railway vehicles for controlling the electric supply circuit with the variation in steam pressure.

974,329. ELECTRIC HEATING DEVICE; C. Aalborg, Wilkinsburg, Pa. App. filed Nov. 19, 1908. A flattened tube containing fluid and arranged in a coil with insulated flat resistance elements adjacent to the outer surfaces of the tube such as a ribbon of steel.

974,330. ELECTRICALLY HEATED BOILER; C. Aalborg, Wilkinsburg, Pa. App. filed July 8, 1909. An electrically heated steam generator with a flat strip of resistance metal and a receptacle with ribs and slots to receive the resistance element.

974,370. UNIVERSAL FLOOR BOX FOR THE DISTRIBUTION OF ELECTRIC WIRES; J. Fountain, Jr., Elizabeth, N. J. App. filed June 24, 1905. Has two adjustable box body sections, one with an inward flange and the other with an outward flange, the sections being universally adjustable upon the flanges and secured in place.

974,389. ELECTRODE FOR ELECTRIC ARC LAMPS; A. Denman Jones, Holloway, Eng. App. filed Apr. 19, 1909. Includes a carbon electrode with projections and chemical material around the core between the projections holding them mechanically to the electrode.

974,396. LIGHTNING ROD; E. J. Kress, Pittsburg, Pa. App. filed Oct. 10, 1908. A fibrous core with a helical winding of wire and a covering of wire which lets the moisture enter the core.

974,415. PROCESS FOR COMPELLING ELECTRIC MOTORS TO KEEP IN STEP WITH THE WAVES OR IMPULSES OF THE CURRENT DRIVING THEM, AND A MOTOR EMBODYING THE PROCESS; J. J. Montgomery, Santa Clara, Cal. App. filed Aug. 28, 1909. For synchronizing motors with the current waves, the moving element being given a succession of positive and negative accelerations.

974,420. APPARATUS FOR HEATING TOOLS ELECTRICALLY; J. Oertly, Cincinnati, O., and Charles F. Dudley, Bellevue, Ky. App. filed Apr. 6, 1907. The iron has an internal resistance with contacts connected thereto, a support with terminals and a holder, the distance between the outer faces of the contacts being greater than the distance between the terminals and a spring pressing the contacts and terminals together during the heating operation.

974,433. SPEED REGULATION FOR DYNAMO-ELECTRIC MACHINES; C. Renshaw, Swissvale, Pa. App. filed Aug. 2, 1905. A polyphase circuit with a motor having a field magnet connected to one phase and an armature connected to the other phase and an auto transformer between the armature and the circuit, the active lengths of the auto transformer winding being caused to vary by a solenoid operated switch according to the speed of the motor.

974,449. TERMINAL CONNECTION; O. Thieme, St. Louis, Mo. App. filed Oct. 28, 1909. For joining stranded conductors by means of threaded insulation pieces which clamp the stranded ends together through the intermediate action of washers arranged upon the ends.

974,462. ELECTRICAL COUPLING; C. H. Bissell, Syracuse, N. Y. App. filed Jan. 27, 1910. A sectional band for clamping a conductor passing through the bore of the band, the sections being pivotally connected at one end and opening at the other.

974,497. ELECTRIC GENERATOR AND MOTOR; D. Kemble, Lakewood, Ohio. App. filed Jan. 13, 1910. Generators and motors with compensating windings for reducing armature reaction, the winding being placed upon a pole piece having a radial slot and a core piece removably mounted therein.

974,506. TELEPHONE RECEIVER HOLDER; H. M. McAlarney, Puritan, Pa. App. filed Sept. 1, 1910. For desk stand. A bracket is detachably connected to the pedestal and has a hinged and sliding portion to hold the receiver.

974,528. ELECTRIC SWITCH; W. M. Scott, Philadelphia, Pa. App. filed Oct. 9, 1909. For making and breaking an electric circuit by double pole switch, the main contact being operated by its toggle and the shunt contact by a cam operated by one of the toggle members.

974,563. AUTOMATIC PRESSURE CONTROLLER FOR WATER AND OTHER PIPES; I. C. Fosler, Chicago, Ill. App. filed Jan. 6, 1908. To avoid excessive pressure in water pipes. A pressure gage controls an electric circuit which operates a motor that drives the pump.

974,565. AUTOMATIC GAS IGNITER; E. E. Gerald, Baltimore, Md. App. filed March 23, 1910. A bracket to be attached to a burner with isulated uprights carried by the bracket, a thermostatic rod carrying a contact pin and a resistance wire connecting an upright and a rod.

974,576. ELECTROLYTIC CELL; G. C. Landis, Wadsworth, and J. H. Smith, Rittman, O. App. filed July 2, 1909. For keeping cells at a low temperature by proving two series of electrodes to form a tortuous path through the electrolyte and a series of non-conducting tubes with parallel coils, one tube between each pair of electrodes, together with supply pipes for the cooling material connected to the tubes.

974,584. TROLLEY; G. A. Millee, McKeesport, Pa. App. filed Apr. 21, 1910. For retaining the trolley wheel upon the wire, especially on curves, by means of retaining members carried on spring pressed barrels, the members having grooves for the wire.

974,608. PROCESS FOR SMELTING ORE; F. T. Snyder, Oak Park, Ill. App. filed July 1, 1907. Passes an electric current between electrodes dipping into a slag bath, feeds the ore, mixed with producing material to the bath, cools the outlying portions so as to form a container by water-jacketing it.

974,610. STRAIN INSULATOR; L. Steinberger, New York, N. Y. App. filed June 17, 1910. The body has a recess and a bolt hole, the recess and bolt hole passing axially through it, the bolt having an anchor plate fitting into the recess with a plurality of other bolts partially extending through the body.

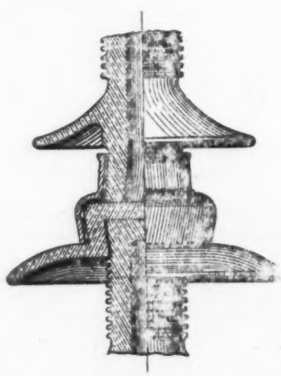
974,611. TROLLEY HARP; W. W. Stewart, Muskogee, Okla. App. filed March 16, 1910. For replacing the trolley harp by means of a guiding U-shaped fork operated by the rope and embracing the wheel.

974,619. AUTOMATIC TRACTION SWITCH; J. L. Yoder, Bellefontaine, O. App. filed Apr. 6, 1910. For electrically operating a switch in advance of the car by means of a solenoid with its core connected to the switch and a contact plate connected with the solenoid, adapted to be operated by a contact arm from the car platform.

974,633. PROCESS OF MAKING AMMONIA, ALKYL AMMONIA OR AMMONIA BASES; H. S. Blackmore, Mount Vernon, N. Y. App. filed Nov. 23, 1908. A horizontally inclined tank rotating on horizontal pivots agitates substances which yield nitrogen and hydrogen, causing their constituents to unite in the presence of mercury under the action of calcium and an electric current.

974,672. INSULATOR; R. M. Johnston, Mansfield, O. App. filed Dec. 23, 1907. A chain of petticoat insulators, including interchangeable sections detachably swiveled together.

974,681. UNIVERSAL CUT-OUT AND SWITCH BLOCK HOLDER; E. R. Le Manquais, Bellemead, N. J. App. filed May 29, 1909. A holder for cut-out blocks with an arm carrying a flange and provided with a slot extending through the flange for mounting porcelain cut-out blocks in cabinets.



974,672.—Johnston Insulator.

974,683. CONTROLLING SYSTEM FOR MOTOR TRACTION CARS; W. C. Mayo, Barstow, Texas. App. filed Feb. 24, 1908. Speed-changing mechanism between the power side of the car and the car axles, controlled electrically, and an electromagnetically operated circuit controller therefor for raising or lowering the speed automatically.

974,712. ARMATURE TESTING DEVICE; L. H. Seyranian, Monterey, Cal. App. filed Dec. 29, 1908. A handle carries fixed contacts which engage movable contacts which engage two commutator bars at the same time and are in circuit with an indicating telephone.

974,741. PROCESS OF MAKING AMMONIA OR OTHER NITROGEN-HYDROGEN BINARY COMPOUNDS; H. S. Blackmore, Mount Vernon, N. Y. App. filed Nov. 23, 1908. See 974,633.

974,742. PROCESS OF MAKING AMMONIA, ALKYL AMMONIA, OR AMMONIA BASES; H. S. Blackmore, Mount Vernon, N. Y. App. filed Nov. 23, 1908. See 974,633.

974,760. ELECTRIC FISHING TOOL; H. Eastwood, Fresno, Cal. App. filed Feb. 2, 1910. For recovering tools from wells. Consists of a waterproof casing with a removable sectional armature plug in the bottom and a series of magnets connected with the armature.

974,762. WIRELESS TELEGRAPHY; R. A. Fessenden, Washington, D. C. App. filed Jan. 14, 1907. Projectors for transmitting wireless in one direction, including a relay for re-transmission and shields protecting one apparatus from the other during the simultaneous operation of the two, the shields changing the wave length when in the immediate neighborhood of the receiver and sender.